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The Control of Machines by Perforated Records

Principles of Pneumatic and Electric Control of Machinery—Difficulties of Automatic Control—Machines Controlled by Paper Records

By EMANUEL SCHEYER

PERFORATED paper control of machinery was first invented about the end of the Nineteenth Century. Joseph Marie Jacquard, a weaver of Lyons, France, to whom the credit is generally given for the invention was, however, preceded by Falcon and Vaucanson, also French weavers, whose efforts in this field laid the foundations for his work. Jacquard invented the loom which weaves cloth automatically into designs in accordance with the holes in a perforated record. Strictly speaking he used an endless chain of perforated cards, each of which in turn was adapted to be moved towards a row of long thin rods or needles pointing end on toward the card. Wherever there was a hole in the card opposite a needle it would pass through and be undisturbed, while those needles coming opposite an unperforated portion would be pushed by the card. The uncut portion of the card would cause the threads of the warp corresponding to it to be kept down, whereas the holes caused their corresponding threads to be raised. The shuttle carrying the weft thread passed through the shed thus formed, and as different cards were moved against the needles, different threads would be raised and the design as predetermined by the holes in the cards, would be produced.

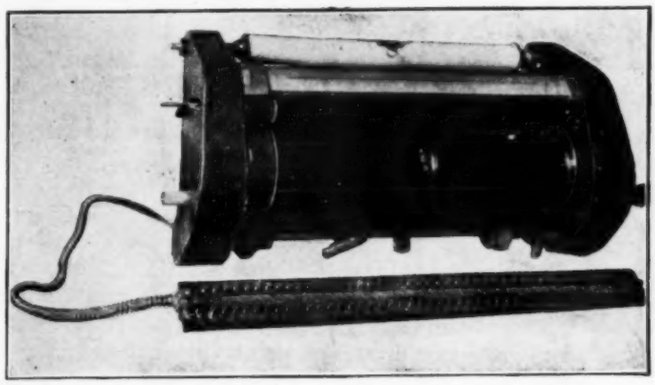


FIG. 1. ELECTRIC CONTROL APPARATUS

Since the time of Jacquard, little has been done in the development of his principle. True, it has been applied to fields other than weaving, notably the playing of musical instruments, the monotype machine, the Hooven automatic typewriter, automatic multiple punches and embroidering machines, but its mode of operation in these other fields, with the exception perhaps of the last two mentioned, is practically the same as it was over a century ago. In some types of automatic embroidering machines, of which more will be said later on, we see the beginning of a development that will some day have far-reaching effects in the world's production.

"It seems entirely within reason to state that no machining operation is so complicated or involves so many movements, so variously timed, as appears in the performance of even a simple musical composition by a mechanical piano-player; and when we consider the accuracy and effectiveness with which the most elaborate compositions are rendered by such machines the applicability of the method to repetition processes in manufacturing seems worthy of consideration. . . .

"The number of operations which may be controlled for any one machine is by no means limited, any more than the number of different musical compositions is limited for any piano equipped for use with the perforated roll. The unlimited possibilities of the Jacquard principle over any other thus constitutes one of its greatest advantages. Any change or modification in a series of operations with the paper strip may be made simply by preparing a different set of perforations, just as one written order of instructions supersedes another; and thus it appears that a form of control in which instructions are positively combined with their execution is available for the most intricate manufacturing operations."*

In most instances where a workman is required to guide a machine in its action, no matter how often its action is repeated in the formation of successive identical pieces of work, he must go through the same motions and mental processes. It is well known that oft repeated thoughts and motions tend to become automatic, requiring little or no mental effort on the part of the operator, in which event he may be said to become a part of the machine itself. Whereas from the humanitarian and social viewpoint this conclusion is cruel and dangerous and should be held erroneous, in the material sense, it is inevitable. Being composed of flesh and blood, the worker must be fed and rested and kept happy, but he is as much a part of the machine he is operating upon as any gear or shaft in it. Owing to constant repetition, a record of his motions is made in his brain, and no matter whether it be a chemical, electrical or physiological transformation, the record exists as a physical fact and the original motions can be reproduced from it at will. Could we but detach this record from him and operatively connect it to the mechanism we would have the very acme of an automatic machine.

*Cassier's Magazine, November, 1912. See also *Literary Digest*, page 126, Jan. 18, 1913.

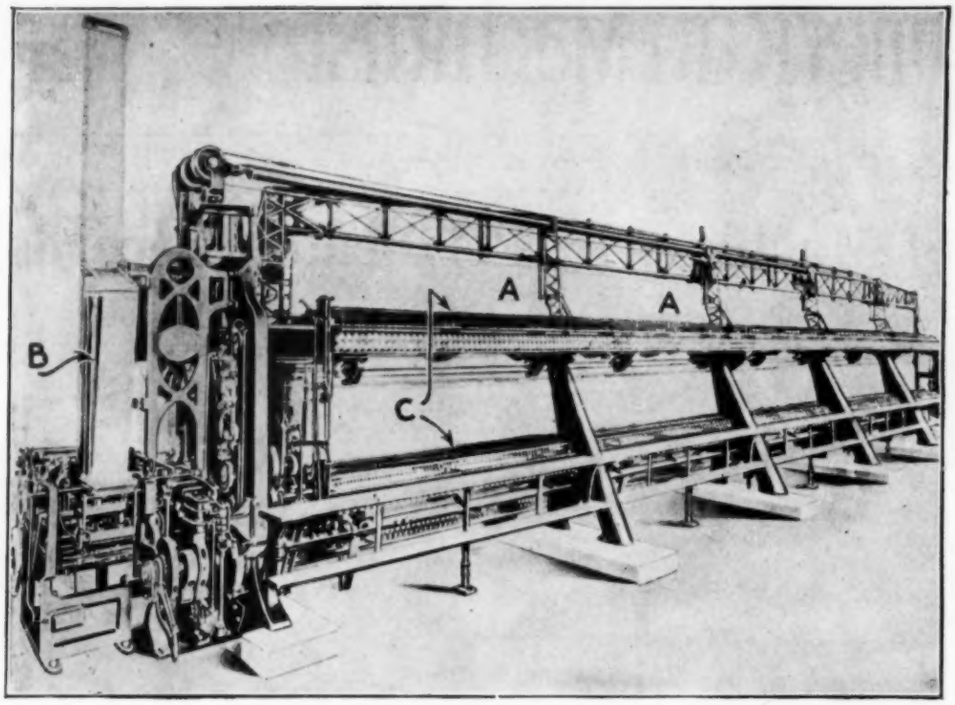


FIG. 2. JACQUARD EMBROIDERY MACHINE

On the other hand, in complicated work, he must keep on the alert and exercise his utmost skill, his actions never becoming automatic, and when duplication is required it seems a great waste that all this mental effort must be repeated.

The comparatively new science of efficiency engineering endeavors to eliminate lost motion and lost thinking in manufacturing operations. Recent progress in this field makes use of the motion picture machine to obtain a picture record of a workman's motions. Gilbreth, an efficiency engineer, analyzes the records thus made and constructs in wire a graph of the path of the hand in performing the operation. It is the next and logical step to replace the hand by a machine part which will imitate the hand's actual motion, the motion being controlled by a previously prepared record.

"There is no more need for the skill of a man's hands to die with him than for the printed record of his thoughts to vanish from the page when he leaves this earth. The movement of the hands, as well as the word spoken by the lips, may become as effectively recorded for future service as the written word or the printed page."*

However, it is not always necessary to imitate exactly the hand's motion as substitute motions better adapted to a machine part may more easily accomplish the same result. The hands and arms are universal tools adapted for all sorts of operations and functions and for none in particular, except perhaps for eating, in which connection the slang expression "lunch hooks" is very illuminating. They are nothing but jointed structures worked by a number of strings and springs of limited range, which may be obviated in a machine designed to order.

The types of control used for producing the motion of the parts of automatic machines can be divided into two general classes. One class is for effecting a pre-determined timing or sequence of action of the parts of a machine, or determines *when* the parts are to come into action. The other class is for bringing about the motion of the parts along predetermined paths as well as for effecting their successive speeds and directions of motion; that is, *how* the parts of a machine are to act. Many controls are combinations of these two classes. An example of the first or "when" class is afforded by the Jacquard loom perforated card mechanism, which determines the sequence in which the threads of the warp are lifted.

It is in the development of the perforated record for controls of the second class, that big things can be looked for. Most automatic machines of this class are controlled by cams, but cams are limited to the control of motion where the distance traveled is short and where the motion follows a fairly simple path. Although the machine itself may run for hours, it is really repeating the same operation over again every few seconds. Linkages may be used in some cases, but they have even greater limitations than cams. The majority of hand-controlled machines are such because no cams can be constructed for the operation of a complicated motion or an operation of long duration through an extended distance. The cams become too

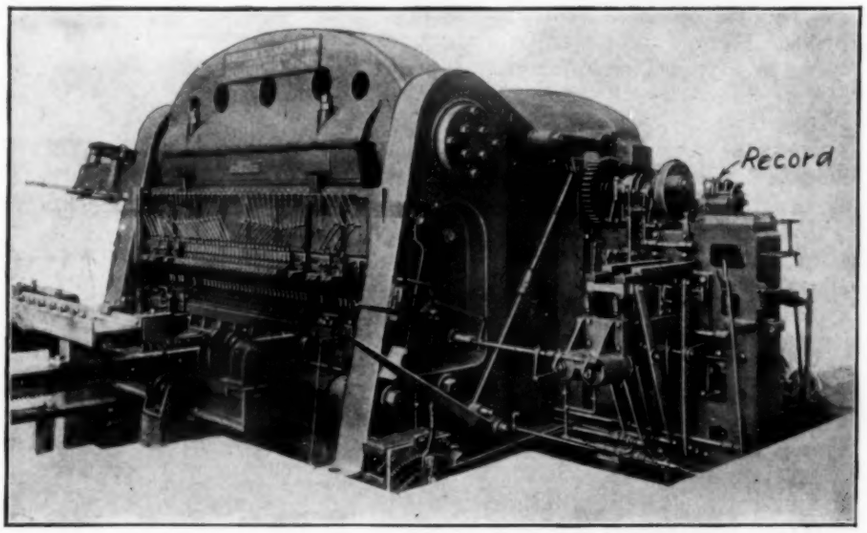


FIG. 3. MULTIPLE PUNCHING MACHINE WITH PNEUMATIC CONTROL. FRONT VIEW, SHOWING ARRANGEMENT OF GAGS AND SPACING MECHANISM

*H. H. Suplee *Scientific American*, page 344, Nov. 1, 1913.

cumbersome and it is often impossible to give them the form necessary for the desired motion. With a perforated paper record, the length of an operation by a machine, be it five minutes or an hour, is of no moment, as paper can be obtained in strips of almost any length. Nor does the complexity of the operation present any difficulty, the only effect being a greater variation in the way the perforations follow each other on the record.

Uses of Air and Electricity

There are two successful types of piano records in use at the present time, one a perforated sheet of very thin paper and the other a perforated sheet of thin brass. While both are perforated they act upon entirely different principles. The paper record controls the admission of air into the operating mechanism, while the brass record, while taking no part itself in the circuits, mechanically operates tumblers to make and break electric circuits. Fig. 1 shows a form of apparatus in which a paper record is used to make and break electric circuits. Here the record controls the admission of air into little cells containing thin leather diaphragms which are puffed in and out against metallic contacts, opening and closing electric circuits thereby.

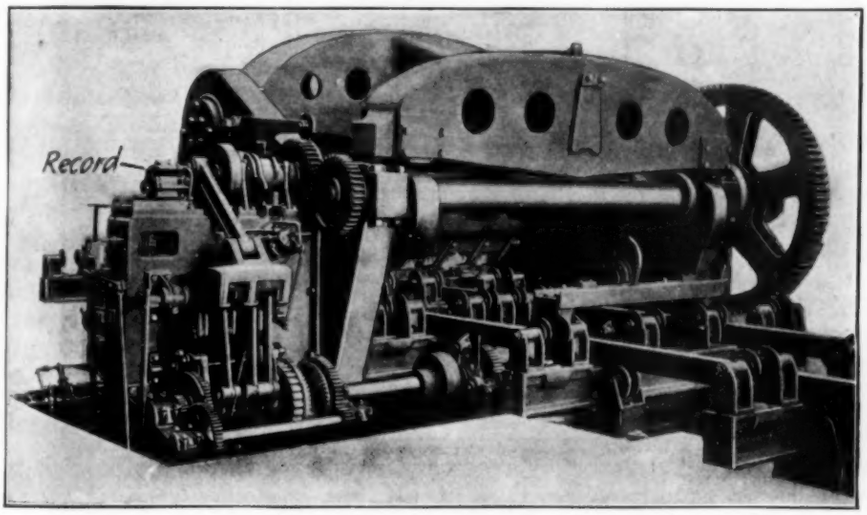


FIG. 4. REAR VIEW, SHOWING DIVIDING WHEELS AND ROLLERS FOR CARRIAGES

Each of the holes shown near the upper part of the mechanism is adapted to close the circuit through a corresponding binding-post. These holes are known as "tracker ducts." In controlling the action of a lathe, the electrical part is omitted, the tracker ducts actuating pneumatic cylinders instead.

It is thus seen that as a piano record is set in motion a series of disconnected impulses are generated, each impulse corresponding to a note to be struck, the various hammers of the piano being actuated at various times. All that is controlled is the time at which the hammers are struck, no control being exercised over its speed or direction of motion. A machine which is to imitate the motion of a hand, or more strictly speaking, a machine which after being put through its various operations under manual control will afterward automatically re-perform these operations, presents a different problem. In this case, all the disconnected impulses acting upon disconnected bodies must be concentrated upon one body and be in continuous control of its motion both as to speed and direction. A step toward this is found in one type of Jacquard controlled embroidery machine, but as will be seen, it is still far short of the desired object.

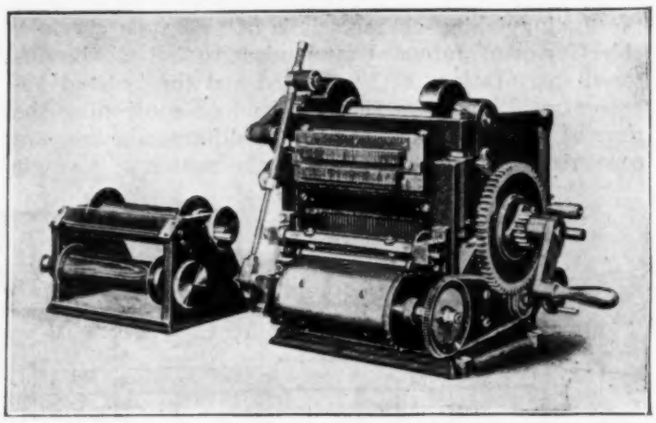


FIG. 5. TEMPLATE PUNCH AND CHECKING STAND

Toward the latter part of the Nineteenth Century the Jacquard mechanism came into use for the control of the motion of the fabric frames of embroidery machines. We see here for the first time the disconnected impulses of the perforated record, concentrated upon the motion of a single body, controlling the extent and direction of its motion for each impulse. To the world in general and even to the engineering world, little is known of these complicated and highly developed machines, one of which is seen in Fig. 2.

The fabric frame of an embroidery machine, which is often as large as 45 ft. long by 10 ft. high, is suspended in a vertical plane. The fabric *A* to be embroidered is stretched over it. The frame is so mounted that it is free to move in any direction in this plane, and counterweighted so that it moves easily and always with a motion of translation. A record *B* which is perforated in accordance with the desired design causes the frame to carry the fabric about in front of the needles *C* whereby the design is embroidered as the needles stitch. All the various motions of the machine are actuated by a rocker shaft which reciprocates a series of links fastened to it at various distances from its center and consequently having different lengths of stroke. The action of the links is controlled by the perforations in the record. The various holes in the record, which is fed intermittently and pushed against rods as in the Jacquard loom, cause a set of driving gears to be rotated. The amount and direction of this rotation deepnds upon the location of the perforations on the record. The driving gears engage with corresponding racks suitably connected to the fabric frame to give it the desired motion.

There is undoubtedly a large and undeveloped field for the application of Jacquard mechanism of the type just described, or some modification of it, to other than embroidery machines. It must be borne in mind that

the distinguishing characteristic of this type over the older forms of Jacquard mechanism is that all the different perforations of the record and the isolated impulses resulting from them instead of controlling the time of operation of a number of different bodies, are concentrated upon the control of the motion of a single body, its direction of motion being controlled as well as its time of operation.

An interesting application of perforated paper record control to metal-working machinery is to be seen in the automatic multiple punches of William Sellers & Co., Inc. The enormous machine shown in Figs. 3 and 4 is controlled by the holes in a frail paper record, heavy structural steel members being moved step by step under the punches which are caused to operate as so many piano keys. Fig. 5 shows the template plate used for making the record.

From a magazine roller, carrying a large supply, located at the back, the paper passes forward under the punches, each of which is controlled by a key bearing a designating figure. The keys are pushed into action by the operator as desired. Each key represents either the engagement of a punch on the machine or a movement of the spacing carriage. After selecting the proper punches and spacing for any stroke of the machine, the crank is turned one revolution which perforates the paper and resets the keys. As the template paper is fed throught the machine it is coiled on a removable roller, and when completed may be transferred to the checking stand shown in the illustration at the left. It is fed through the checking stand by hand and the perforations examined for the detection of possible errors.

In the manufacture of structural steel, it is necessary to punch thousands of rivet holes with all sorts of irregular spacings. Instead of laying these holes out by hand or by the use of templates, a paper record is made in the drafting room. Some of the holes in the record control the distance the steel member is to be moved between punchings, and others of the holes select which of the punches are to come down for each of the settings.

A huge punch bar reciprocates over a row of punches, its downward stroke just falling short of the top of the punches. When a piece of metal, known as a gag block, is thrust between the reciprocating punch bar and the top of a punch, instead of falling short of the punch at the end of its downward stroke the punch bar now drives this particular punch by means of the intervening gag block. A gag block is provided for each punch, and each gag block is attached to the piston of a pneumatic cylinder. A tube extends from each of these cylinders to the record and when a hole in the record comes over one of these tubes, its corresponding piston is pushed out, bringing a gag block in position over a punch. The work is mounted on a carriage which moves over rollers. To the underside of the carriage are attached two parallel racks with which a

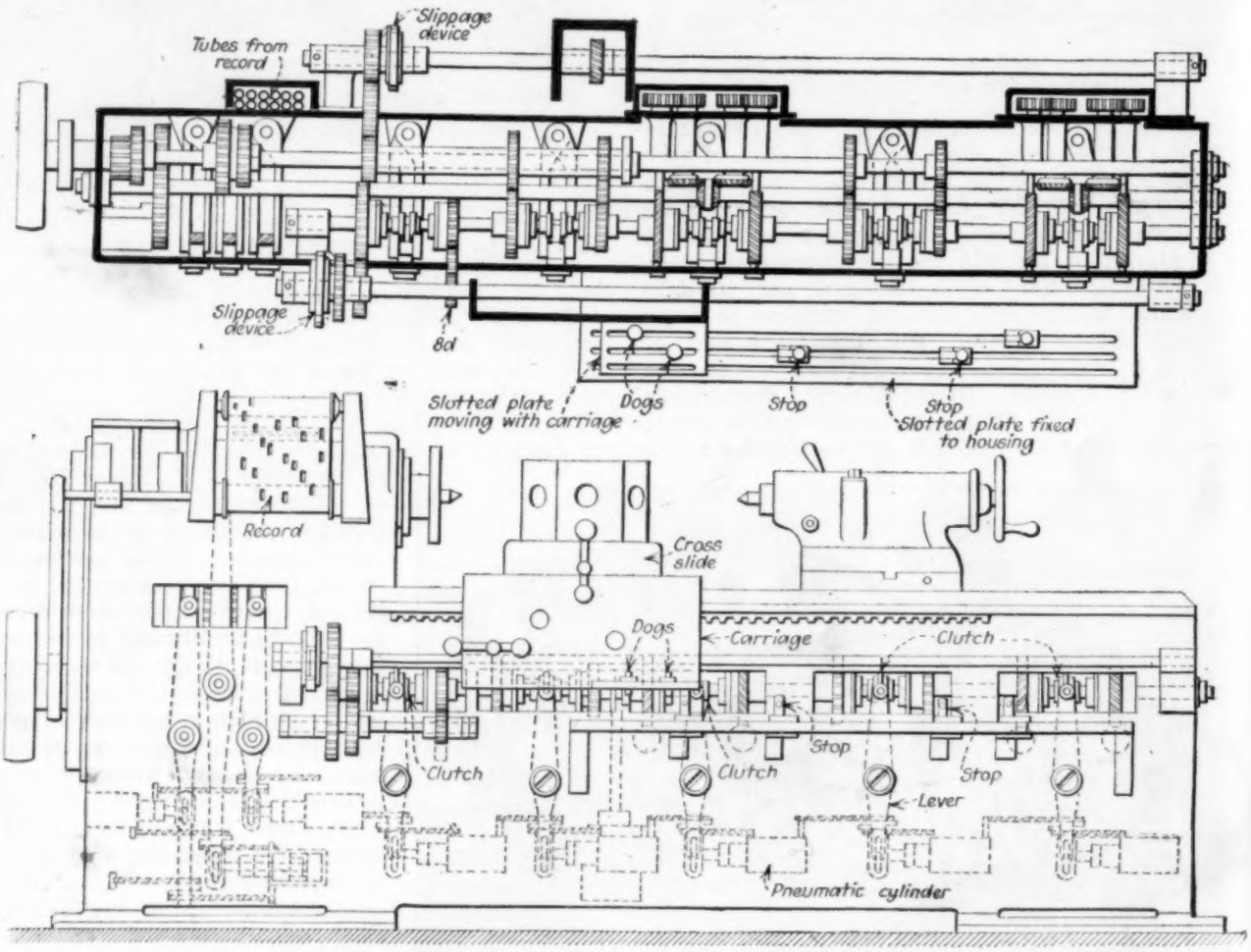


FIG. 6. (Below) FRONT ELEVATION OF PROPOSED RECORD-CONTROLLED LATHE. FIG. 7. (Above) SECTIONAL VIEW JUST BELOW BED OF LATHE

set of driving gears engage. The rotation of these driving gears, and hence the movement of the work, is controlled by the record. Attached to the driving gears is a ratchet wheel which rotates a partial turn at each stroke of a pawl. The length of stroke of the pawl is controlled in differing amounts by corresponding holes in the record, much the same as described in the embroidering machine mentioned before. As in the embroidering machine, the record is fed with an intermittent motion.

Why Not Apply This Principle to the Lathe?

A modified form of the Jacquard, adapted for the control of machine tools of the turret type, is proposed by the writer.

The lathe equipped with the Jacquard cannot compete with the ordinary cam-controlled automatic lathe for certain classes of work. It is suited for handling work which is larger or more complicated than can be handled by cam-controlled machines; such work as at present can be more economically made on a hand-operated turret lathe or an ordinary engine lathe.

The cross-slide, Fig. 6, is controlled in its motion from a slotted feed shaft in back of the bed of the lathe (Fig. 7) and the carriage is driven by a feed shaft in its usual location in front of the bed. Clutches are used to cause the engagement and disengagement of these shafts with a power shaft, the gearing between them and the power shaft being such that reversals of direction can be obtained by the engagement of some of the clutches. Others of the clutches bring into play different sets of gearing whereby the traverse and feed of the carriages can be varied in speed. Still others of the clutches control the different spindle speeds. All of the clutches are shifted by levers, one end of the lever being forked over the sliding part of the clutch and the other end fastened to the piston rod of a pneumatic cylinder. As air is admitted on one side or other of the piston in the cylinder, the clutch is thrown into engagement with its mating parts. The action of the cylinders is controlled by the perforations of the record, which choose the cylinders that are to operate as well as the length of time the pistons are held in any desired position. The motion of the perforated record, which is fed continuously, is similar to that used in automatic pianos, except that in this case the perforations control the motion of levers instead of operating the keys.

Owing to the fact that when the clutches controlling the motions of the carriage and cross-slide are thrown in by the perforations of the record the carriage and cross-slide may overrun or fall short of the required motion, so a number of adjustable dogs and stops are provided to arrest the motion at the correct places. The cross-slide and carriage have projecting from them slotted plates in which the dogs can be bolted in various positions and in a similar manner the stops are bolted in various positions in corresponding slotted plates fixed to the housing of the machine. Certain perforations in the record control the action of these stops, a stop being able to arrest the carriage or cross-slide only when the corresponding perforation comes into position.

In Fig. 8 it can be seen that the upper end of the stop is beveled and rounded off while its lower end is bifurcated. The stop swings about a pivot supported in an upright which is fixed to a base, which can be bolted to one of the slotted plates. A piston rod is adapted to enter the bifurcated lower end of the stop and thereby prevent it from turning about its pivot. When a perforation of the record corresponding to a

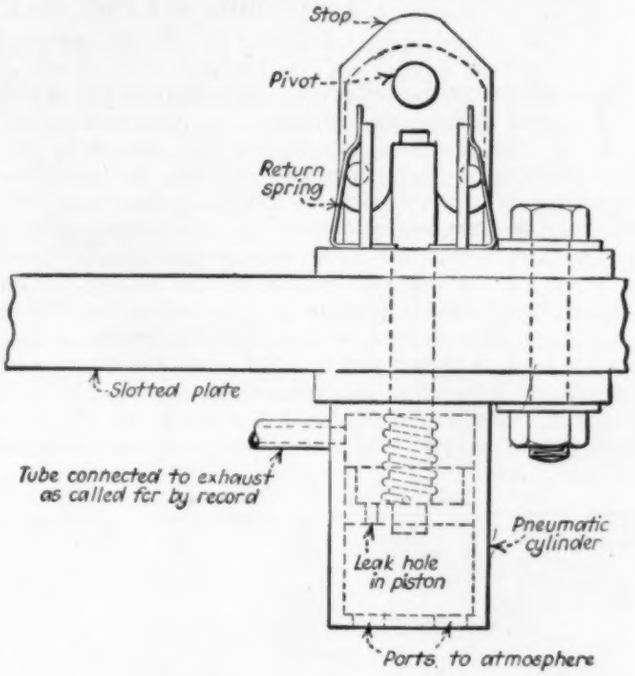


FIG. 8. PNEUMATIC CONTROL-STOP

particular stop comes into proper position, air is exhausted above the piston, which causes the piston to rise against the pressure of the spring which normally keeps it at the bottom of the cylinder. As the piston rises it forces the piston rod into the bifurcated end of the stop and now, when a dog fixed to the carriage comes against it, the motion of the carriage is arrested. When any other dog passes over a stop, as there are no perforations calling for the actuation of the piston it is kept down by its spring. As the dog goes by, the stop is rotated about its pivot until the dog clears, when springs bring the stop back to its vertical position. The perforations for the stops are so placed on the record that a stop is thrown in before the perforations calling for the engagement of the corresponding clutch are out of action, thus causing the carriage or cross-slide to be used against a stop, the feed shafts being provided with a slippage device which permits part of the driving mechanism to be rotated by the clutches while the other part is stationary. The slippage device is adjusted to have sufficient grip to hold for the cutting action of the tools, but will give when the carriage is arrested by a stop. It resembles in principle that used in the Hartness flat turret lathe, in which the carriage is fed against a stop which arrests its motion even though the operator continues to operate the feed.

Having determined the operation, speeds and feeds necessary for turning out a given piece, the record is laid out in the drafting room and the lathe is set up by fixing the tools in the turret and setting the dogs and stops in their proper positions. Now as the record feeds (with a continuous motion) the various perforations control the motions of the carriage and cross-slide as well as their speeds of feeding and traversing and the desired successive spindle speeds.

Machining Motor Parts for Northway Trucks

Describing Some of the Jigs and Fixtures Used in One Shop—Method of Lightening a Crankshaft—A Good Milling Fixture

By ROBERT MAWSON

THE writer has undertaken to describe some of the more interesting operations in the manufacture of the Northway truck, which is made by the Northway Motors Corporation, Natick, Mass. This concern produces two sizes of trucks, having capacities of 2 and 3½ tons, respectively.

The first operations in machining the cylinder head are milling the top and bottom of the casting. This is then bored for the pistons in a "Hole Hog" as shown in Fig. 1. The casting is placed in the fixture resting on the base as shown and forced against the stop screw *A*, at the left, with the knurled head screw *B*, and against a stop at the rear with the screws *G*, after the swinging clamps in which these fit have been brought into position.

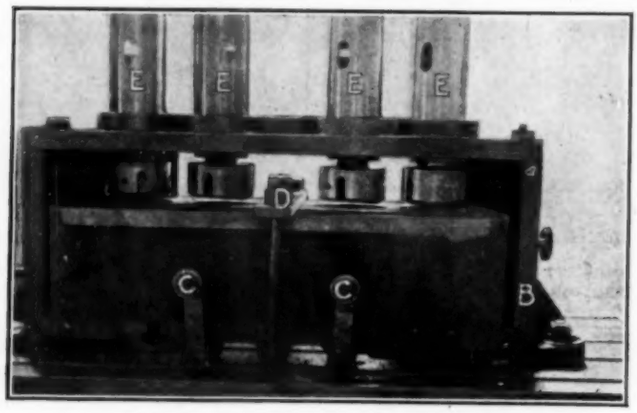


FIG. 1. BORING CYLINDER HEAD

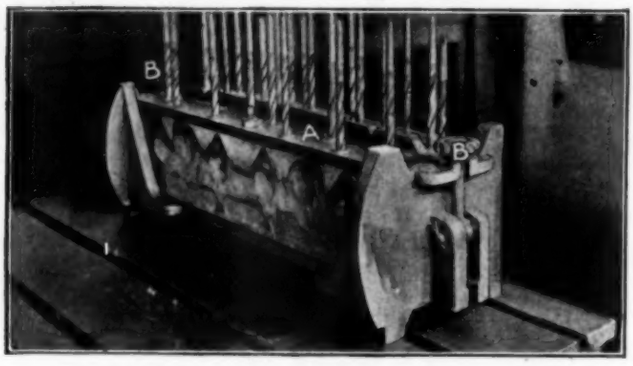


FIG. 2. DRILLING CYLINDER HEAD, VALVE SIDE

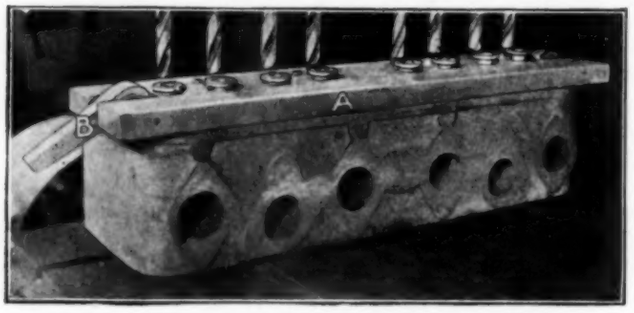


FIG. 3. MACHINING VALVE STEM HOLES

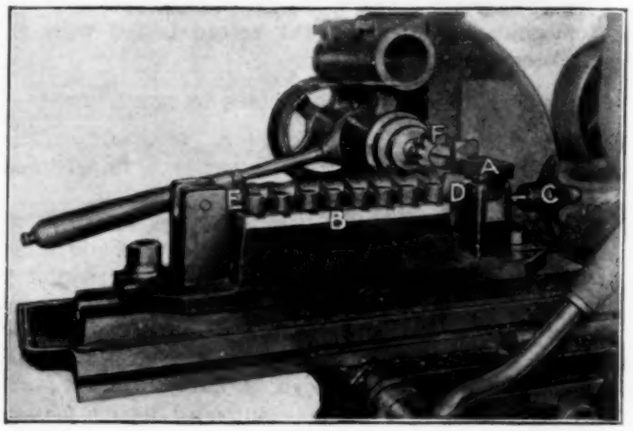


FIG. 4. MILLING ROCKER ARMS WITH FORM CUTTER

The clamp *D* is next tightened and the pressure exerted by it holds the casting securely in position in the fixture. The cutter bars *E* are guided through long bushings in the fixture cover so that the holes are bored parallel, after the spacing of the bars has been once obtained on the machine. Two sets of boring heads are used for the machining operation, the final set leaving enough material in the holes to grind out to the finished diameter of 4 inches.

The next operation is drilling the holes on the valve side of the cylinder head and is performed in the jig shown in Fig. 2. This tool is made with a cradle into which the casting is placed, being located by means of two cylindrical plugs, integral with the jig, which fit into the holes that were bored in the previous operation.

The cover *A* is then placed in position, being located in its relation to the cradle or base with two dowels, the swinging bolts are placed in their respective slots in the cover and as the knob nuts *B* are tightened on the bolts, the cover of the jig is thus fastened down securely on the cradle.

Drilling Stud Holes

With the casting in this position twenty ¼-in. holes are drilled half way through the cylinder head and six holes are drilled which are later tapped for ⅜-in. studs and used to hold the rocker arms.

Referring to the illustration, it will be noticed that the jig is made with two circular ribs on one side, these being provided so that the operator can turn the jig over, bringing the base to the top. This feature makes it unnecessary for the man to raise the tool from the table as would be the case if the sides had been made square box shape.

The jig now assumes a reverse position and the operation of drilling the twenty ¼-in. holes is completed. These holes are the clearance-holes for the studs by which the head is attached to the cylinder. It will be seen that bushings are provided both in the cradle and cover to guide their respective drills, and the operation is performed in a multiple-spindle drill press.

The casting is then transferred to two multiple drill

presses facing each other, where the eight valve stem holes are machined. The set-up for this operation is shown in Fig. 3. The holes are first drilled to ⅞ in., the piece being again located by means of two circular plugs fitting in the holes bored in the first operation.

The cam levers *B* of which there is one on each end of the jig, are then raised and as the inner end comes

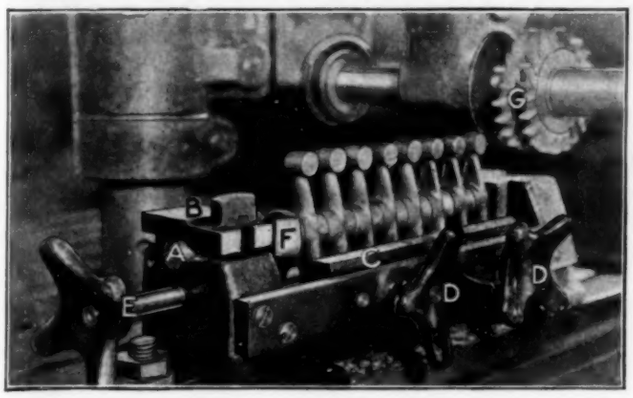


FIG. 5. STRADDLE-MILLING ROCKER ARM BOSSES

under the inside flange of the casting, the jig is forced down and held securely in position. The holes are then drilled, the tools being guided through the bushings shown.

The jig and casting are then transferred to the multiple drill press facing the one shown and the bushings exchanged for a set to suit the reamed sizes, after which the eight holes are finished.

Machining Rocker Arms

The first operation in the machining of the rocker arms is drilling the fulcrum pin hole, a simple jig being used which is not shown here. The arms are then placed on the pin, eight at once, in the fixture shown in Fig. 4. The pin with the forgings is then swung down and held with the clamp *A* the pieces resting on two steel surfaces, of which one is shown at *B*.

The binding screw is next tightened by means of the knob *C* and this exerts pressure on the block which forces the forgings along the center pin to the stop collar *E*, thus holding them for the milling operation and preventing chattering. The machining of the pieces is performed with the formed cutter *F*, after which each rocker arm is tested with a gage to see if sufficient material is left on it for the next operation.

The pieces accepted are then placed in the fixture shown in Fig. 5, being placed on the pin *A* which is held by the clamp *B*. The steel bar *C* is next forced against the forgings with the two knob nuts and screws as shown. The action of this bar is to force the various rocker arms back against stops at the rear, thus locating them accurately in relation to the surface machined in the previous operation.

The knob and screw *E* being tightened, force the forgings along the pin on which they are mounted to the top shoulder shown at the rear end of the pin, thus holding them against machining stresses. The gang cutters *G* are properly set to obtain the desired width of boss and as the table carrying the fixture and pieces passes under the revolving mills, the rocker arms are machined as desired.

The milling of the intake manifold is done on a Potter & Johnson automatic using two cutters, one cutter operating on the cylinder flanges and the other on the carburetor flange. The construction of the two fixtures is very similar and the one employed for the latter operation only is shown here.

After the cylinder flanges have been machined, the casting is placed in the fixture shown in Fig. 6, with the finished surfaces resting against the wall *A*, being secured in this position by the screws *B*. Two clamps *C* assist in holding the pieces rigidly in the fixture.

The carburetor flange is then machined with the inserted end milling cutter *E* the empty spindle *F* being used to hold the cutter employed to machine the cylinder flanges when the two fixtures are in use together.

Machining the Crankshaft

Some of the operations followed when machining the crankshaft are of unusual interest. Machining the line

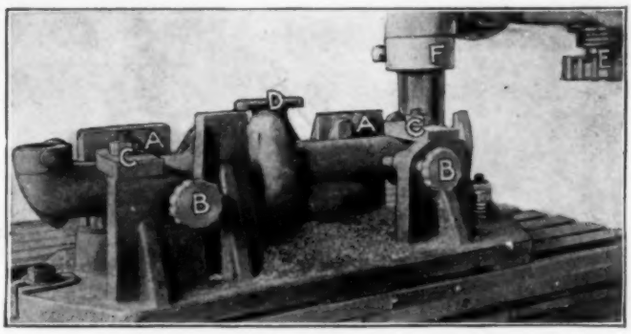


FIG. 6. MILLING FLANGE ON INTAKE MANIFOLD WITH INSERTED TOOTH CUTTER

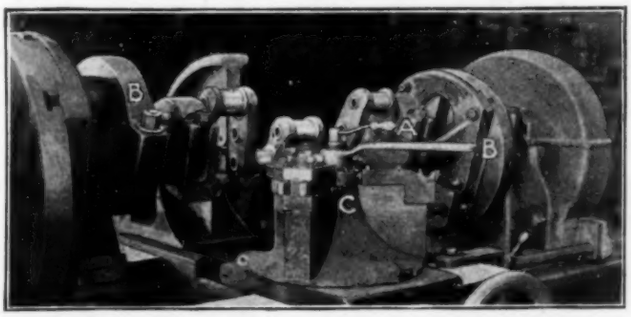


FIG. 7. TURNING CRANKSHAFT BEARINGS

bearings on the crankshaft is a simple lathe proposition, as they are all in line and can be turned all at one setting. When machining the connecting rod or throw bearings a different method must be used in order to get the proper throw and also to turn the various bearings so that they will be parallel with the line bearings.

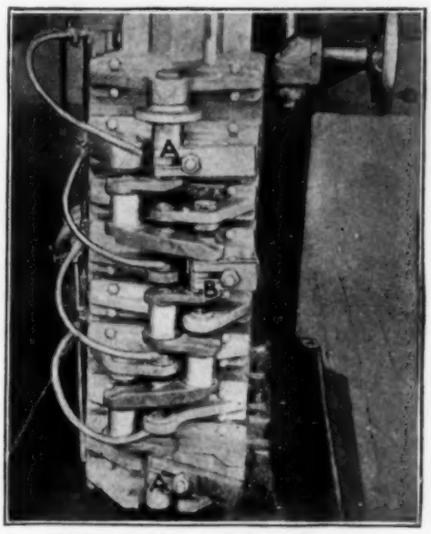


FIG. 8. DRILLING BEARINGS LONGITUDINALLY

The crankshaft lathe shown in Fig. 7 is used for this work. The outside bearings are held in the V-clamps *A*, one at each end, the two faceplates *B* being over from the center an amount equal to half the throw of the crankshaft, and one set of connecting-rod bearings are machined. The crankshaft is then revolved 180 deg. on

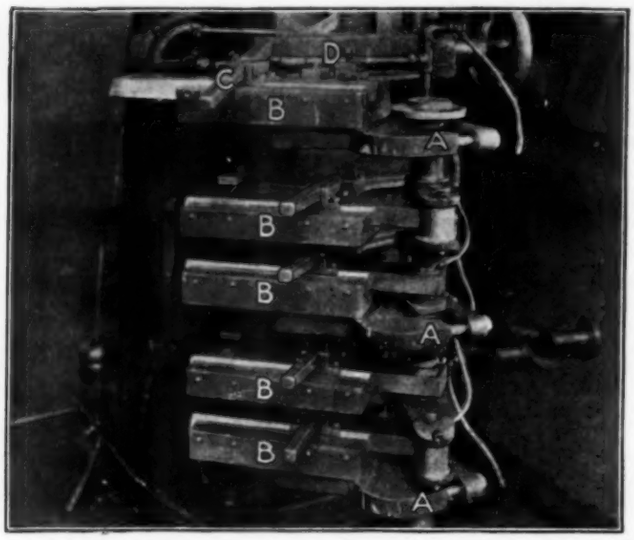


FIG. 9. REAMING HOLES IN CENTER BEARINGS

its axis and placed in the V-blocks again and as the throws are an equal distance from the main bearings, the other set of connecting-rod bearings are in position for the turning operation.

The tools used for turning these bearings and forming the radii are carried in the special toolpost *C*. It will be seen that the crankshaft is held rigidly in this lathe and the drive is positive so that after the faceplates have been correctly located all the bearings will be the same, having similar throws. As this concern makes all its motors with the same stroke, it is not

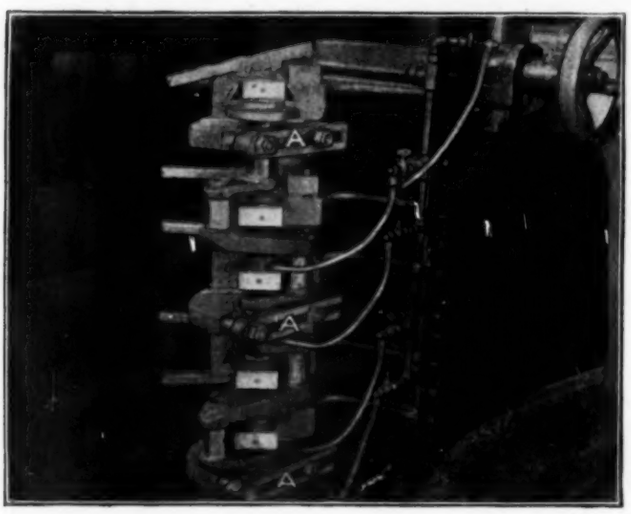


FIG. 10. ANOTHER VIEW OF REAMING FIXTURE

necessary to change the position of the faceplates after they are once set.

Lightening the Crankshaft

In order to lighten the crankshaft, holes 1¼ in. in diameter are drilled through the entire length of each bearing. The jig used for drilling these holes is illustrated in Fig. 8. The shaft is located and held in the jig by clamping both end bearings in V-blocks as shown at *A* and *B*.

Bushings are provided in the jig for each bearing, so that the drill is guided for the entire length of the holes. Lubricant is also fed through the four pipes as shown to assist the drilling operation.

The holes in the main bearings are then finish reamed in the fixture shown in Fig. 9. The shaft is placed in the three V-blocks *A* which act as locating points, being held by the clamps shown.

Sliding Bushing Blocks

The five sliding bushing blocks *B* are then pushed into position to guide the reamer. The operation of these blocks is rather novel and can be seen better by referring to the top one which is not in position. The man taking hold of the handle *C* slides the block along until he can drop the inner end of the handle between the two blocks (*D*), at which point the bushing is in the correct location.

Another view of the fixture is shown in Fig. 10, from which a better idea of its construction can be obtained. The locating V-blocks and clamps are shown at *A*. It will be noticed that the sliding blocks that hold the guide bushings are of dove-tail construction, provided

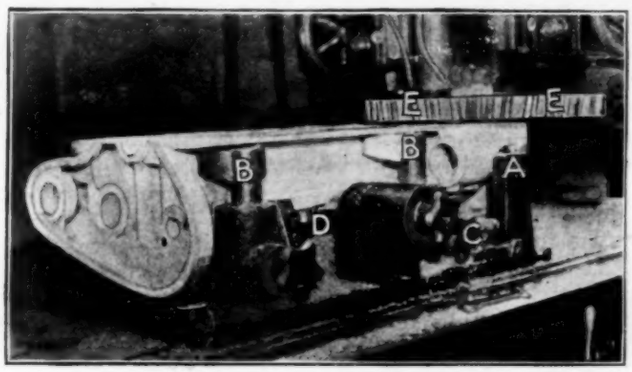


FIG. 11. SURFACE-MILLING CRANKCASE

with gibs for taking up wear and to allow for adjustment.

The two machines on which the driling and reaming operations were performed are next to each other and in close proximity to the crankshaft turning lathe, so that the pieces pass along in sequence of operation to the final assembling of the motor.

Milling the Crankcase

An interesting fixture shown in Fig. 11 is used to hold the crankcase for milling the cylinder face. The casting is placed on three fixed pins, one of which shows at *A*, the other two being on the rear side. Spring plungers *B* are then allowed to come up against the under side of the flange, where they are fastened in position by means of the knob screws shown.

It will be seen that these plungers are made with large heads, so that the thin flange is well supported. The screw *C* is then tightened and this operates the equalizer *D*, forcing the crankcase against two stop pins at the rear.

Clamps are next tightened on the inside of the piece to hold it and the machining is done with the inserted tooth milling cutters *E*, which are large enough to finish all the surfaces at once.

Why Prices Are Cut Below Cost

Danger of Trying To Maintain Prices on a Falling Market—Effect of Price Guaranties—A Failure Hurts the Whole Community

By ERNEST F. DuBRUL
General Manager, National Machine Tool Builders' Association

MANY business men who are caught at the crest of a buying wave with a high cost stock seem to think their goods are not going to be sold below that cost, and they hang on in desperation, trying to get their money out, instead of taking their loss. This is because they do not understand how business moves in cycles. They do not understand that the price that they are going to get for their goods has nothing to do with the cost of production of those particular goods.

On a rising market they are very much gratified to find prices going up, and that goods that they have held can be sold out at a higher rate of profit because new goods cost more. Their ignorance of the converse is pitiful. When the wave recedes they cannot understand that the same fundamental principles apply—that is, that *it is cost of reproduction that will govern the price of goods.* They try to hold out in the face of decreasing costs, and to at least get out of their sales the cost of the goods. Those who hang on in desperation finally take a larger loss than they would have had to take if they had quickly reduced their prices with the receding demand, and stepped down easily and gracefully, instead of finally falling over the precipice with a dull thud.

One reason why prices are cut below costs is that business men work themselves into a financial state that compels them to jettison cargo to save the ship. The larger the excess stock, unwisely or unfortunately accumulated, the greater is the loss.

The most common cause of prices going below the real cost of reproduction is due to sacrifices that have to be made by those somewhere in the system who have allowed their tanks to fill up too far and too fast, and who did not realize the rate of flow down through the system, and who did not regulate their own valves so that the supply would be adjusted to demand.

Some men have thought that prices and supply can be artificially controlled. They have gotten together and made agreements to divide territories, or to maintain prices, or to restrict output, and by various other devices to control the flow artificially. But these arbitrary, unnatural devices never have worked for any considerable length of time. They never can, and they never will work. If men, either individually or collectively, attempt to maintain their prices at an artificially high level, they simply bid for additional competition, and the higher the level they maintain, the stronger their bid is, begging competitors to come in and share their ill-gotten gains. And the competitor comes in, at some time or other. One of those who has begged the new competitor to come in begins to realize that the new competitor is getting a large share of the business, and is able to keep his plant full up while those inside the combine are only working to partial capacity. His interests demand that he break his agreement with his competitors—and he does it, and reduces his price—and the rest follow.

In the resulting scramble for business, prices go on down until they go so low that it does not pay anybody to make that particular line of goods, and there they stop, because they cannot go any farther. If the new competitor has provided more facilities than the market justifies, or if the old competitors together have added more facilities than the market actually justifies there is an essential waste of capital, measured by the amount of excess facilities.

Society does not benefit by having an over capacity. That capital came from somewhere—either from profits, or savings, in other lines of business, or out of the same line itself. Perhaps, in the last analysis, it did not come out of income at all, but actually came out of the patrimony of the country in the way of natural resources. An industry in that shape simply has to sit down and wait for the country to grow up to its capacity. The inefficient, or less efficient competitor will finally be wiped out. If his plant is out of date and is not worth salvaging, the plant will be wiped out. But if his plant is able to produce about as cheaply as the others, the plant will not go out of business, but new capital will buy it in at the sheriff's sale at a price below its cost of reproduction, and the new capital will be in a much more favorable competitive position than the old competitors. The reorganized plant will be trading on the losses of the previous owners and will not have to earn as much money to pay dividends on the new capital as the old ones will have to earn. It has been found by hard experience that it does not pay to try to put competitors out of business for that reason. Nature provides its own remedy for economic ill health.

If a man foolishly builds a sky scraper out in the suburbs of a large city, when he tries to rent it he cannot find tenants enough to fill it and to pay his operating expenses, to say nothing of interest and profit on the investment. But very few people are quite so foolish as that in the building line. They know that the demand for sky scrapers is not out in the suburbs, but down in the business sections, where more people want sky scraper offices. Therefore sky scrapers are built where the demand is. In other words, they bring the supply of floor space to meet the demand.

Unfortunately, the ordinary business situation is not so clear, and as a consequence we find a great many industries that are over-built, having entirely too much capacity for the real demand for their product. Very few industries have been able to know indefinitely what is the real amount of their demand.

No man goes into business in which he is sure that he is going to lose money. He perhaps knows that there is some chance of losing it, but he figures the chances as mostly in his favor, and not against him, otherwise he does not go in. If his information is defective and he does go in, not knowing what is the real demand for his product, he tries to keep on forcing his product on the market through lower and lower prices. His competitors follow him on down, and finally prices are below the costs of some of them, and some of them go out of business. This restricts the supply and the next buying wave comes along, increases the demand, and those who are left can make a little money.

The same process is repeated on the next wave with new and equally ill-informed producers.

This is another reason why prices go below the cost of production. Practically all of the reasons get down to mal-adjustment of supply to demand, and that mal-adjustment is due to ignorance of the amount of both supply and demand.

Effect of Price Guaranties

In dull times many devices are used in the attempt to force a product on a market that is actually glutted. One such device is the *guarantee of price*. This practice is childish in its futility, but like other things men do through economic ignorance, it simply results in compelling others to cut below the one making the guarantee—it has just the contrary effect to the one expected. A man guarantees a price against decline to save himself from making a cut, not knowing that thereby he compels his competitor to undercut him, and eventually forces down his own price that he wanted to stabilize.

Nobody is ever asked to guarantee prices against decline except when a market is so evidently on the down grade that the buyer feels the need of such protection. When the sellers are hungry for business, they often try to get it by offering inducements other than straight reduction in prices, and then we hear of guaranties of this sort.

The question is, what are such guaranties really worth?

This question can be properly answered only from the point of view of fundamental economics. Last winter demand for automobiles was much below what it was a year before. Large automobile factories faced more or less idleness, and saw their overhead mounting, with relation to their sales. Buyers were apathetic as well as scarce, and the automobile makers were hungry for business. They had large stocks of high-priced materials on hand and did not want to face any more loss than they had to. Some, who evidently knew nothing or cared nothing for the economic law of the general equilibrium of prices, thought it possible to continue operations and stimulate business by guaranteeing not to reduce prices before May 1. They probably honestly believed that prices would not be reduced, then. So the guarantees were made effective.

A few buyers who were flush enough with money to buy anyhow felt that they had some sort of protection, but the orders they placed would probably have been placed anyhow. Other buyers knew that as everything else was coming down it would be impossible for automobiles to retain a price level above their economic basis and simply deferred their purchases or fixed up their old cars for another season. On the whole, it is doubtful if the high cost inventories were actually cleaned out at the higher prices, for by common report the automobile industry continued dull, and the price guaranty did not stimulate the trade in general.

But certain makers did not guarantee and maintain their price, they reduced prices and sold cars, and later reduced again. These few maintained a fair rate of production. But the others stuck to the guarantee. If they had sold a fair number of cars they would have had to rebate large sums in cash, and cash looked good this spring of 1921. The buyer who bought could well look out for himself, but numbers of these are very sore because prices were reduced, and very materially, although the price guarantee was almost universally cited in evidence of the impossibility of that occurrence. Those who maintained their prices have let a good part of their selling season go by, and are trying to get the trade going by making greater reductions than they would have found it necessary to make if that had been done earlier. Those reductions do not get back the good will lost.

Price guarantees lead competitors to cut under a natural price, and then compel the guarantor to go still lower to get back his fair share of the trade he lost by holding out against natural tendencies. They simply set in motion an economic force that acts exactly contrary to what was expected when they were started. Price guarantees are a sure sign of a weak market, and the wise buyer who is compelled to buy at the time is always glad to get them. They eventually give him a price that he really could not get at the time his order has to be placed.

Effect of Inelastic Demand

Price wars frequently start because some men do not realize that their demand is truly inelastic, and imagine that they can take orders enough to fill up their own plant when the actual available demand for a product has shrunk, due to a receding of the buying wave. They figure because overhead distributed over a larger number of units shows lower costs, that they can afford to offer their goods at a lower price and thereby get enough business to fill up the plant. This is true as a manufacturing proposition, but as an economic proposition it is fallacious when applied to a product of inelastic demand.

At the height of a buying wave with all stocks depleted. with the consumption valve wide open, with the manufacturer pushing everything through his "production" as hard as he can, unfilled orders keep mounting up, because he cannot produce as fast as orders are poured into his plant. Such a condition does not continue long before somebody increases facilities to get out all those orders. Yet considering demand over a period of years, the whole industry cannot possibly be run full time all the time. Pretty soon the buying wave recedes, cancellations blow off the excess pressure of unfilled orders, consumption is shut off, and stocks pile up again at a surprising rate. The system clogs. Then concerns that had been running at full capacity get the bright idea that they can keep on running by making lower prices than the economic level of that particular time really justifies for the industry as a whole.

What happens? Soon after their lower prices are made, every competitor is told about them, and probably told some false news as well as the truth. Every competitor knows that if he is going to maintain his relative position in the industry he has to reduce his prices to meet those of the first reducer; and he does it. Then the first man, still trying to fill up his production, makes another reduction. That is followed by the others, till bottom is reached. The attempt to run full time when the restricted market demand does not allow the whole industry to run full inevitably fails.

Suppose that at the peak of the demand the total market and total production facilities were able to produce but 100,000 units a month. The wave recedes, and the market is absorbing only 50,000 units a month. One competitor who had been making 1,000 units a month at the peak thinks that he can maintain more than his relative position and he tries it. For a while

he may get a little more; but at the expense of his other competitors. But just as soon as they reduce their prices, he finds that his sales rate is no faster than 500 units a month. He figured his profit on the basis of 1,000 units a month, and he was willing to sacrifice a part of that to maintain a full rate of production, but in the final windup, when his production comes down to 500 units, through his competitors meeting his price, he finds he has sacrified some of his capital. He did not want to do that. He did not deliberately expect to incur a loss, but he did not see that his action would kick back onto himself. He only demoralized the whole industry, which would have been going along on a level of price that would at least carry overhead, and perhaps interest and depreciation over the whole period.

Many men who know nothing about the waves of business make this same mistake. Society as a whole does not profit by it because society as a whole will pay, and must pay the total cost of the goods that it requires; and that cost includes a profit sufficiently great to induce sufficient production, in the long run. If an industry were perfectly well regulated, it would figure its costs in such a manner as to take care of the waves up and down. Profits are of two kinds. One kind consists of normal profits, which are required to produce a normal supply for normal, steady demand, and the other kind are called conjunctural profits, which can be reaped only at times of excessive demand, in relation to supply.

Too many men deceive themselves with the idea of the "normalcy" of conjunctural profits, which are entirely abnormal. If they finance their business only on that basis they are sure to be financially weak when the next depression comes, and they lose their previous profits and a part of their original capital, trying to keep afloat.

If they sink they not only lose their own money, but almost always some of their creditors' money as well.

An Old-Time Radial Drilling Machine

BY MILTON WRIGHT

The radial drilling machine shown in Fig. 1 is an example of the thoroughness with which the old-time machine tool builders put up their product. The machine was built by the Whitworth Co., Manchester, England, and purchased from them in the fall of 1867 by Baxter D. Whitney for use in his shop at Winchendon, Mass.

Arriving in this country in December of that year it was immediately set up and has been in service practically ever since. A year or two before the European war broke out it was retired to make room for a more modern tool, but during that period of pernicious activity it was reinstated and is on the job to-day, drilling holes within its capacity just as well, if not quite as fast as its neighbor.

It has many of the features of the modern semi-radial type of machine, including the power driven elevating screw for moving the radial arm up and down the column. The screws and gears are in good condition and show little evidence of their half century of service. Except that the drive is too light for so heavy a machine, it is to-day an excellent example of machine design.

It is not a "universal" machine; that type belongs to a later period. It will drill holes only in a direction parallel to the column, but that it will do as capably as if it were built yesterday.

As a reminder of the days when typewriters were

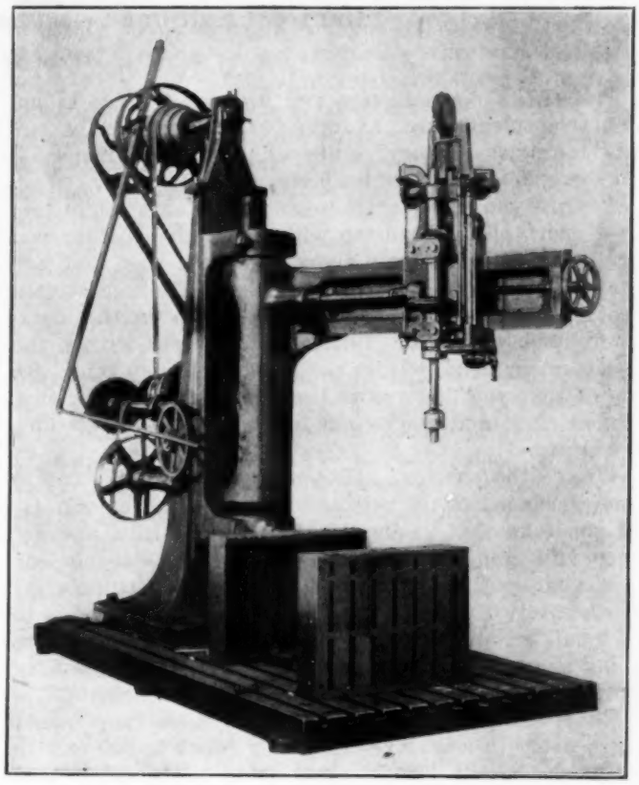


FIG. 1. AN OLD ENGLISH RADIAL DRILLING MACHINE

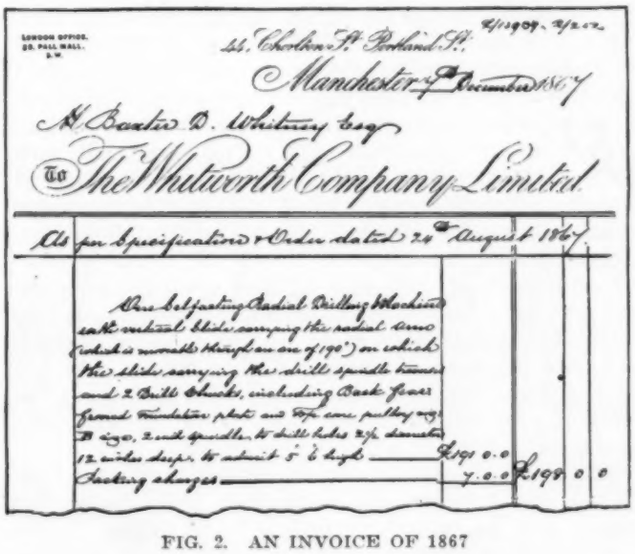


FIG. 2. AN INVOICE OF 1867

unknown and all business correspondence was painstakingly carried on in longhand, the Whitworth Company's bill for the machine is shown in Fig. 2.

England's New Dreadnaught

The firm of Armstrong, Whitworth & Co., England, is said to have been awarded the contract for one of the new superdreadnaughts ordered by the English Admiralty, at a cost of £7,500,000. It is estimated that it will require three years and the services of 500 men to complete the vessel.

Organization and Management of the Small Shop

IX. Going After Business—Cause and Effect of Readjustment—Opportunity for the Real Salesman—Some Pointers on Advertising

By E. W. LEACH

SMALL shop managers and owners of large industrial plants are, at this particular time in our country's history, quite alike in one respect—they've got to go after business.

Picture yourself starting out for an automobile trip in a sporty little roadster with so much pep that you think it's going to jump right up off the road and into the air. Your tank is full of gas, you strike a stretch that's smooth and graveled, so you step on the accelerator and let 'er go. But something goes wrong, the engine stops dead, it just naturally quits you cold. On top of that you find you've been running on a flat tire. It's raining, and you're hungry. The service stations are closed.

What's the answer? Do you try to push the car in somewhere out of the rain and start walking home? Or do you take that casing off, look at the tube and get busy with your cement and patch? And do you look over your engine until you find where the trouble is? There are two ways of handling the situation; one is to be a quitter, and the other is to determine that you are going to get where you started for in spite of the hard work and the set-backs that you did not anticipate.

That is exactly the problem the small shop owner faces today in a way he has never faced it before. In other words, the quitters are going to be eliminated along with those who still think they are are on the joy ride that selling was equivalent to during the war; but the go-getters are going to get there.

Early in the fall of 1920 the buyers of the country decided it was time to begin deflation, time to put the prices of commodities on the downhill slide. As a consequence, we had what was called the "buyers' strike." It really did not start with the public at all, but with the manufacturers themselves. They were farsighted enough to see the economic danger in running along indefinitely on the abnormal basis they had been running on during the war.

Curtailment of purchases filtered down through the various links in the merchandising chain until the public, too, was holding back. It was a losing proposition, and the business men who were good sports and good business men took their losses with a smile in the form of reduced prices and reduced values on inventories, and sailed in with a fresh start.

The policy of buying from day to day then went back up the line from the public through the retailer, the jobber and the manufacturer, until the prices of raw materials were affected. As a consequence, the material cost of many manufactured products was lowered. And as there was a lessened demand for goods, there were less goods made, and a great army of unemployed workmen was the result. Those men who stayed by their jobs realized that a new industrial era was commencing, that new standards of efficiency and production would be demanded of them, that the old theory of "the survival of the fittest" was again coming into force. So labor raised its individual efficiency to prevent its wages from being lowered, and labor costs joined with material costs in sliding down the scale.

Lower costs permitted manufacturers to put lower prices into effect; the confidence of the buyers gradually returned; and at the time of writing the tide has definitely turned and business is on the upgrade.

"Back (?) to Normal"

"Back to normal" is the slogan someone suggested during all the commotion, as an expression of their desire to speed up the readjustment that would take the shakiness and unsteadiness out of Mr. American Business Man and enable him to walk once more with firm feet on solid ground. If we could only have caught that expression before it was put up to the public and changed it ever so little, what a lot of misunderstanding we could have prevented.

Back to normal times—it's that very first word that spoils it, because so many people have unconsciously substituted the word "backwards" and given themselves the unfortunate idea that they and the whole country actually ought to retrogress. This idea is absolutely out of all reason. Do you realize what it would mean to you and me if we had to go back ten years and begin again to build up from that point? Do you realize what a tremendous calamity it would be if all manufacturers jointly issued a bulletin saying, "Beginning the first of the week the prices of our goods will be exactly the same as were in effect before 1914; we will pay 1914 prices for our materials and supplies; we will give our men 1914 wages"?

Just think of what would happen if the back-to-normal idea were carried out exactly as its meaning has been suggested to some of us.

Progression to Normalcy

And is that what we want? No, the good old days of the past are gone forever. We don't want to go back to normal times, we don't want to go *back* to anything. It is true indeed that there must be a gradual change in the relation between price, production and profit; but let's make it a matter of healthy development; let's make the step a forward one! We can get back to normal just as easily and much more satisfactorily by going *ahead* through a new conception of the possibilities of the job before us.

A business never stands still long. When it does stand still, it is losing out. So you cannot stand still during the crucial days that lie ahead. You've got to go one way or the other. It's much easier to slide downhill than to climb uphill; but in the first case you land at a lower level, whereas if you choose the latter you reach the higher grades and put yourself in a position to realize the bigger things that are always to be found at the top.

Let's forget about days that are past and look into a future that can be just what we make it. Let's adopt a slogan, "Bigger business, bigger profits," equip ourselves to go after it, and get busy.

And where do you, Mr. Small-Shop-Owner, step in in this enthusiastic resolve to fight the fight with renewed vigor? Your place is entirely up to you. It can be just what you decide to make it. There is room for all, there is business for all. You only need to stir up some

dust and then see how many dollars and cents there are in it. But it is a job that requires many characteristics that have been slighted for a while. It brings again into play a good many muscles we have permitted to become soft. Muscles strengthen through use, through hard work, and that is the kind of exercise the small shop owner must take if he is to experience continued success.

It is a case of exit the order taker, enter the real salesman. A few years ago we had too many orders, now we have too much goods.

And what are the knowing ones doing? Are they sitting fearfully at home hesitating to venture forth into added activity just because there is talk of labor unrest, Bolshevism and war? Are they laying down on the job because that is decidedly the easier thing to do? Are they drawing a line through their advertising appropriation because they feel that the results may not justify the expenditure?

They are not; not a bit of it. They are continually drumming up new business, and finding new ways to increase their sales. Of course that is a busy job, and it doesn't leave them any time to talk about depression. They realize that the business is there even though it is unquestionably harder to get; and they're going after it. During the winter they all tightened up a bit; it wasn't a retreat, they were just "digging in." It was a temporary entrenchment while they strengthened themselves for real aggressive fighting this spring, the kind of fighting that carries a man over the top to win.

No Substitute for Work

The new condition is not a temporary one, it is permanent. Fortunately or unfortunately, as you may wish to look at it, no one has ever invented a substitue for work. The new condition simply is that you have got to work harder to get the same amount of business. It is not a condition that will eliminate the small shop and retain the large industrial organization. No, any process of elimination will not make its division in that way.

Small shops and large ones stand together in the bid for business, and together they will be eliminated who are content to take the business that just comes in to them and accept it as a windfall. But those who continually put more energy and effort into the selling of their products and make that a more definite and more important part of their business will prosper and expand just as surely as modern civilization will endure.

This is my chapter on salesmanship, although I have purposely sidetracked any declaration that I am either the originator or even the proud possessor of the "Ten Sure Secrets of Successful Selling." The only business secret really worth while is to have no secrets. And salesmanshsip is a profession for which no Book of Rules will ever be printed.

Common-Sense and Salesmanship

A salesman is not a sleight-of-hand performer. In marketing your goods, you cannot adopt the rôle of a clever trickster, overwhelming your prospects with a dazzling line of patter, pronouncing the magic words "plooey plooey" and then retiring gracefully, leaving your man utterly bewildered and wondering how you did it.

Selling is a very matter-of-fact proposition. And marketing your product is a job quite devoid of any presto-chango stuff.

Your product may be but a reflection of your own self, and an indication of your own genius; but your selling methods must breathe the very confidence and absolute sincerity you have in those goods. It is a psychological process. You have some goods, the other man has some money. You want him to trade his money for your goods. He puts up a resistance, always; he offers objections, and you must overcome them. When you have done so, the man is sold. Your job then is to realize that he is sold and not talk him out of it by not knowing enough to quit. It isn't the number of words you put into your sales message that counts, it's their effectiveness. A few well directed shots will have more effect than a whole company of rookies shooting at random.

Whether prices go up or down, whether taxes go higher or lower, whether interest rates increase or decrease, people will have to be clothed, fed and sheltered, and there will always be a demand for exchange of money for the products of the man who is willing to work. A farmer might have the best cultivator in the world, but if he had planted no seed in his field he could harvest no crop. Selling is the process of harvesting the crop, advertising is planting the seed, and so they are very closely related in the work of going after business.

The Function of Advertising

One of a person's most active organs is his "forgetter." Advertising prevents people from forgetting you. It is a continuous barrage of publicity of various sorts that keeps your name and your goods as frequently and constantly as possible before the attention of your trade.

Your advertising should not be a group of picture puzzles—clever, far-fetched layouts that suggest something as far from your product as black is from white, but which try to tempt your reader on through three or four unfoldings or turning of pages until (if he has the time and patience) he finally discovers what you have to sell. I like good, outspoken, short and sweet, "reason why" copy. That's all your prospect wants, it's all he needs, it's enough to sell any article of merit.

Testing Your Advertising

When you write a sales letter or the copy for a folder or a magazine advertisement, go over it a second time and substitute the word "victrola" in each place where the name of your product is mentioned. If the ad sells the victrola as well as your goods, something is wrong. Your message is just full of meaningless generalities, it doesn't tie up directly with your merchandise.

Your sales and advertising messages should not only tie up unmistakably with your goods, but they should be distinctive. By always using your trade mark, by always using the same colors, by using some one typical layout, you can make your messages easily distinguishable as *your* messages. You are not a philanthropist; you are not trying to sell your competitor's goods also. You are rightfully selfish, and you are justified in making your sales message pull business into *your* shop alone. In fact, you might easily be accused of disloyalty to your own business if you were guilty of sending out literature that sold other people's goods as readily as your own.

If your literature is easily distinguished, customers will say at a glance, "Here's something else from the Blank people—wonder what they've got to say this time." Right off the bat you have their attention, and that is half the battle.

I am reminded, in closing, of the village that was temporarily without a pastor for its church. A visiting pastor registered at the hotel one day, and they persuaded him to remain over Sunday and deliver a sermon at the church on the condition that he was to receive half of the free-will offering. As the reverend gentleman entered the church that morning he noticed a box just inside the door over which was a sign, "Free-will offering," and, wanting to present a good example to the congregation, he dropped in a dollar.

After the service was over, he found only his own dollar in the collection box; but true to his agreement he took half a dollar and left half a dollar. His small daughter, who was with him, noticed that he was not at all pleased with the morning's work, and she said to him consolingly, "Well, Daddy, if you had put more into the box yourself, wouldn't you have gotten more out of it?"

You'll get out of your business in direct proportion to what you put into it. There will be a definite ratio between your sales efforts and your sales returns. The harder you go after business, the more you'll get. The whole world respects and admires the man who is striving to attain a goal.

Saving Space in the Lathe Department

BY AMOS FERBER

Screw machines are commonly placed at an angle with the line shaft, the machines overlapping for the purpose of making room for the long bars of stock projecting from the spindle. The Waterville Machine Co., Waterville, Conn., adopts the same method of placing motor driven engine lathes for a very different purpose.

PLACING MOTOR-DRIVEN ENGINE LATHES AT AN ANGLE

By placing the lathes as shown in the illustration, with the angle considerably increased over that used in placing screw machines, a passage way is left between each machine, the light is on the faceplate just where the operator wants it, many more lathes may be placed to a given length of bench space the operator is not compelled to go around the machine to reach the bench, as is the case when lathes are placed back to back in double parallel rows.

An added advantage of this method over the double row lies in the fact that the headstock of one lathe cannot throw oil all over the work and operator of the lathe in the rear.

How Long, O Lord! How Long?

An editorial that appeared in *Electrical World*, Oct. 29

Before the people of the United States today there stand some of the most serious, complex and pressing problems that any nation has ever faced. They call for honest analysis, for balanced judgment, for positive decision, for constructive legislation and for prompt action. In Washington are ninety-six senators and four hundred and thirty-five representatives, each one selected, empowered and paid to do this job—and Congress talks and talks and talks.

The country is burdened with an unjust system of taxation that is hard to pay. People are sick of it. They know that a different arrangement—preferably the sales tax—will produce the needed revenue and yet make taxes easier. The administration has promised it. The country waits. But Congress talks and talks.

The old economic relationships between America and Europe are turned topsy-turvy. Our export trade has gone to pieces. The tariff must be readjusted. Business needs it. The administration has promised it. The country waits. And Congress talks.

The railway systems of the country cannot pay the dividends their stockholders are entitled to. They cannot even maintain their equipment and replacements. They are powerless to better these conditions until they receive a settlement from the government. This settlement will loosen a flood of railway orders that will bring tremendous stimulus to business everywhere. The administration has promised it. The country waits. But Congress talks and talks.

America has a huge fleet of merchant ships. A few are profitable. Many are running at a loss. Hundreds upon hundreds are tied up idle. They cannot operate under our existing shipping laws in competition with foreign flags. The administration has promised to right the situation. The country waits. And Congress talks and talks and talks.

How long, O Lord! How long?

America today is pleased with its administration. President Harding and his well-chosen cabinet have the confidence of the country. These men are doing their utmost to work out these and our other problems, to support our industries and to restore good times—while in Congress this one orates about the glory of the Republican (or Democratic) party and that one declaims about the perfidy of the honorable gentlemen on the other side.

The *Electrical World* believes that the situation has reached a stage where it has become the duty of business executives and individuals to call upon their senators and representatives in Congress by letter, by wire and in person, and ask them flatly: "What have you done or even said to hurry through the work we pay you for?"

A bulletin is being prepared weekly, having begun on Oct. 15, 1921, by the Western European Division of the Bureau of Foreign and Domestic Commerce, which contains abstracts of communications from the representatives of the Department of Commerce in western Europe not otherwise appearing in print, as well as abstracts of items of news culled from the many periodicals and newspapers received by the bureau from western Europe not readily accessible to many who are interested in foreign trade in that part of the world. The buttermilk will be mailed free upon application.

A General Method for Spring Design

Types of Springs—Economy Index and Load-Deflection Rate—General Formulas and Table of Constants—Parallel Scale Chart—Importance of Material Index

BY JOSEPH KAYE WOOD
Engineer, Western Electric Co., Inc., A. T. & T. Co.

WHEN an engineer finds he needs resilient action of some kind in a certain piece of mechanism or machine he is designing, the questions which confront him are:

1. What type of spring will best fit the allotted space?
2. What load-deflection rate is required?
3. Will the spring criterion of the spring selected to satisfy the first and second requirements be *less* than the material index of the material selected; or in other words, will the spring be safe?

To find the answers to these questions the engineer usually consults a handbook first, and if not satisfied with the brief information found there, he secures a book on the mechanics of materials, which also will give incomplete or indefinite information on springs. There are, however, a few noteworthy treatises on springs, chiefly in pamphlet form, which he may consult, but which usually will lead him into a maze of complex formulas briefly described. This very often results in confusion.

The above statement is not intended as a criticism of the authors of these treatises. On the contrary, we should be indebted to them, but the trouble is due to the generally indifferent attitude shown toward the development of this branch of engineering, which compelled these men to cover an immense subject in a very brief space. For instance, in "rigid construction" design the subject of elasticity was extensively studied in order to limit and allow for its undesirable effects, while in spring design where elasticity is fundamentally essential it was not so carefully studied. Spring design has a greater claim on the subject of elasticity; and, for this reason, should not the combined interest of engineers, mathematicians, metallurgists and chemists be directed toward a careful and thorough investigation of elasticity as applied to this branch of engineering?

It very often occurs that an engineer will make a short investigation in order to secure the information he requires, and then again, a great many engineers will make a "guess" of the various dimensions of the spring. All of these attempts to secure the information necessary for the design of the spring, or "guessing," will, I venture to say, in 60 per cent of the cases involve considerable loss of valuable time and labor. To be able to confidently design a spring within practical limits in the shortest possible time requires, I believe, a grouping of the widely scattered information and data on springs in a careful and systematic manner. To this purpose I am writing this article as a nucleus around which the complete subject of spring design from an engineering standpoint may be built.

General Fundamentals

Resilience is the energy which we can obtain from some materials when stressed, due to that inherent property called "elasticity." The distribution of a highly elastic material, as some metals, in a given space, so as to obtain a certain resilient force at any desired point constitutes what is known as spring designing. There are, however, an infinite number of ways a material may be distributed; but, as a general rule, it is done in such a way that the force delivered at a certain point can be predicted within practical limits by the use of formulas derived from a few fundamental laws discovered by experiment.

Consider a straight piece of highly elastic material whose length is L, and whose cross-section is constant in area and shape. The line parallel to the length and passing through the center of gravity of the cross-sections may be called the "geometrical axis" of the material. Now there are four general ways in which this material may be stressed in order to obtain an amount of resilient energy W, as follows:

(a) Stretching, or plain tension.
(b) Bending, or flexure = tension and compression.
(c) Twisting, or torsion = tension and compression.
(d) Combined bending and twisting = tension and compression.

Cases (a) and (b) were covered in the last two articles by the author (*American Machinist*, pages 46 and 674) on spring design, and (c) was covered in the three previous articles on helical spring design. Subject (d) has not yet been made the subject of an article.

Hook's law, which was discovered by experiment, is the fundamental law upon which all spring formulas are based, and is written as follows:

"Strain is proportional to stress for loads within the proportional limit of the material."

In all except case (a), there are some fibers which are not stressed when a load is applied to the material. In case (b) these fibers lie in a "neutral" plane perpendicular to the load and coincident with the geometrical axis, while in case (c) the "neutral" fibers are coincident with the geometrical axis. Therefore, a second fundamental law, also determined by experiment, covering cases (b) and (c) is as follows:

"The stress increases uniformly from zero to maximum from the neutral plane or axis to the outermost fibers of the cross-section of the material."

This law is true only for the twisting of the "neutral" plane due to bending alone in case (d), but the stresses of the entire section occurring in the outermost fibers resisting the combination of twisting and bending are not covered by this law.

Therefore, from these two laws the following general formula for total resilience was derived in the previous articles:

$$W = U \times \frac{S^2}{2E_T} \times volume, \qquad (3)$$

Where S (maximum stress in volume) and E_T modulus of elasticity for tension) are approximately constant for any one material; and U, which may conveniently be called the "economy index," depends on the method of stressing and the cross-sectional shape.

In stretching, case (a), every fiber in the material is stressed an equal and maximum amount, i.e., to a value just within the proportional limit. In this case, then, the maximum possible amount of resilient energy is obtained, which gives as a result the most economical

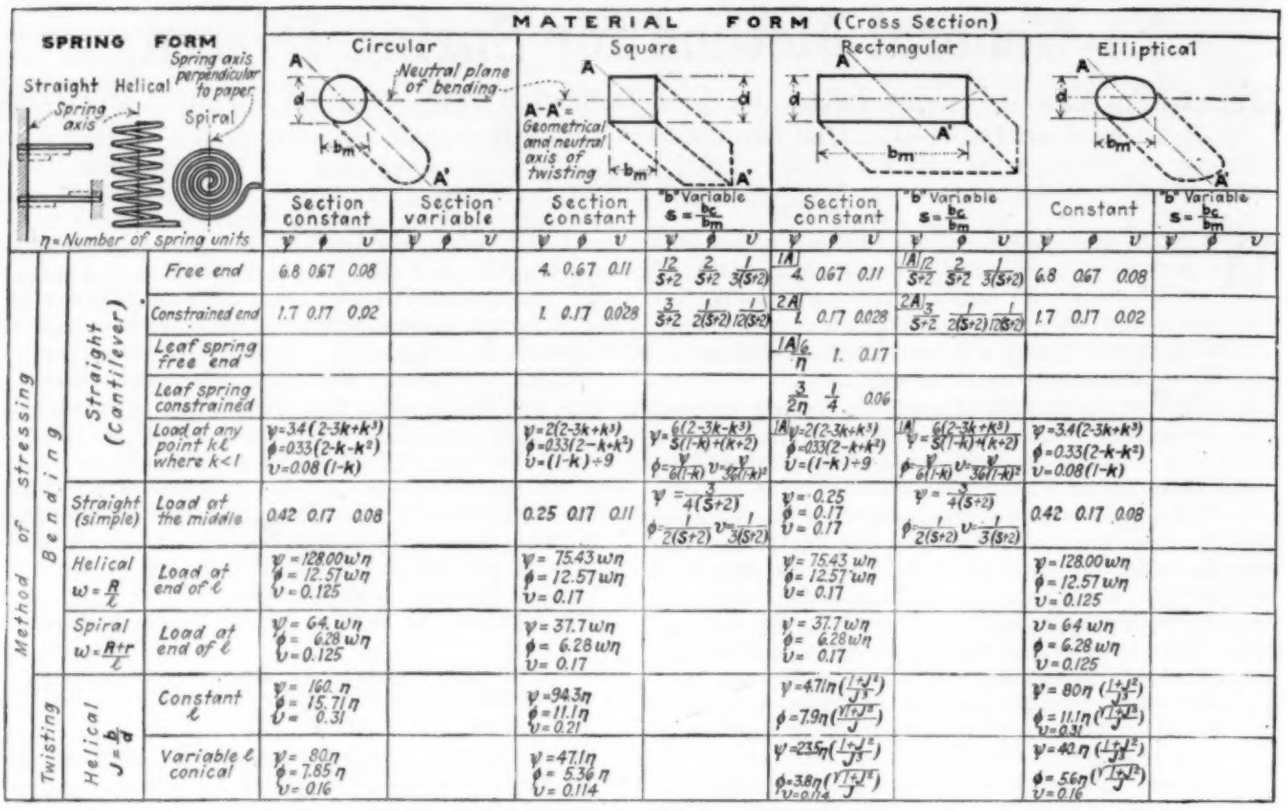


FIG. 1. TABLE OF CONSTANTS FOR DIFFERENT SPRINGS AND LOADS

condition in the use of this volume of material as a source of resilience. Hence, the economy index U for case (a), which is equal to unity in formula (3), is greater than U for the other three cases (b), (c) and

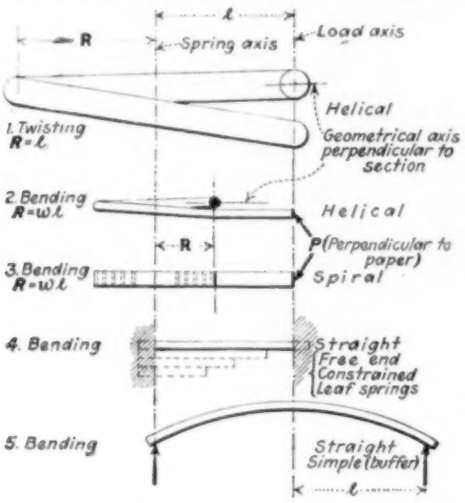


FIG. 2. METHODS OF LOADING SPRINGS

(d), because in these cases every fiber is not worked to its maximum limit. From the values of the economy index given in the table, it can be seen that for the bar of material under discussion now, the method of twisting, case (c), has a higher economy index than bending, case (b). This is because there are more idle fibers contained in the neutral plane of bending than in the neutral axis of twisting.

Furthermore, the economy index for stretching, case (a), remains unity no matter what the cross-sectional shape happens to be, but the economy index for all other cases is greater for a section which has the material distributed more remotely from the neutral plane or axis, i.e., a greater moment of inertia, because in this way more fibers are stressed to a maximum and nearly maximum value, i.e., a higher average value.

Economy vs. Deflection Rate

However, for the materials used for springs the modulus of elasticity is relatively high (5,000,000 to 35,000,000), which, in the cases where the economy index is unity or nearly unity, has the effect of making the "force" component of the resilient energy very large and the "distance" component very small. For this reason the "stretching" method, case (a), is found impractical for use as springs. If a highly elastic rubber rod which has a very low modulus of elasticity were stretched, the distance component would be fairly large for moderate loads; but, of course, it is quite obvious that rubber is unsuitable for springs. It is also obvious that the necessarily long lengths required would be impractical for use for resilient members.

It follows, therefore, that only a part of the maximum possible amount of the resilient energy of the volume of material under consideration should be utilized at the cost of economy, i.e., of a high economy index, in order to decrease the force component so as to give a low deflection rate suitable for springs. That is, in a general way, we might say that the low deflection rate as indicated by the value of the modulus of elasticity for spring materials must be greatly reduced by the methods of design in order to give a suitable low deflection rate for resilient members of mechanisms. We might, therefore, speak of the latter low deflection rate as the "modulus of elasticity for the spring M," as distinguished from the modulus of elasticity for the material E.

Bending, case (b), as we said before, does not call upon all the fibers to do the maximum amount of work safe for the material used. Hence, in every case of bending, the economy index is less than unity. However, the value of the economy index for bending may be varied over a wide range by varying the inertial shape of the constant cross-section with respect to the neutral plane; and the greater the moment of inertia the greater the index. It may also be increased, but to a less extent, by varying the sectional dimension parallel to the neutral plane, or the breadth, throughout the length L; for instance, the tapered spring. Then again, this index may be increased by the manner in which the load is applied; i.e., by constraining only one end of the spring, or by applying equal and opposite couples to the ends of the material as in coiled springs. In these latter instances the increase in the economy index is brought about due to the fact that more fibers are stressed to a maximum and nearly maximum value, the tapering and coiling tending to stress all the outermost fibers to a maximum value.

In the constrained cantilever the outermost fibers at the two constrained ends are stressed to a maximum value, which reduces the average stress for the whole volume; whereas, in the unconstrained cantilever only the outermost fibers at one end are stressed to a maximum, thereby increasing the average value. Increasing the economy index in these various ways for the particular volume of material under discussion, decreases the "modulus of elasticity for the spring," and will make this modulus too low for practical use if the moment of inertia of the cross-section is not limited. For this reason, the section dimension d, Fig. 1, perpendicular to the neutral plane, is usually a great deal less than the dimension b, parallel and coincident with the neutral plane. The square section which should be the limit in this respect has a moment of inertia 1 greater than that of the circular or elliptical section of the same area, and consequently has a greater number of fibers in the maximum stress zone.

In twisting, case (c), the spring also has its economy index increased and the "modulus of elasticity of the spring" correspondingly decreased, when the moment of inertia is increased. The "modulus of elasticity for the spring" corresponding to the circular section is most commonly used, and that of the square section occasionally used, while those of the rectangular or elliptical sections are rarely used.

Combination bending and twisting, case (d), having the limitations of cases (b) and (c), will permit a higher economy index because more fibers are stressed to a maximum or nearly maximum value.

Spring Forms

So far, we have considered a definite volume of a highly elastic material of length L. Now, if L is made very large as compared with the dimensions of the cross section, that is, keeping the volume the same as before, in either case (b), (c) or (d) the economy index will be constant, with a correspondingly large increase in the load-deflection rate. But, a very long piece of material would be impracticable as a resilient member in a mechanism, hence the material is coiled helically or spirally, in which form it is more conveniently fitted to a given space. These forms are called springs. For a thin material in the spiral form (clock springs) the load-deflection rate will be so large that nearly constant loads may be obtained for appreciable deflections, thereby making this form of spring ideal as "storage tanks" of resilient energy. Each convolution or turn may be considered as a spring unit, and the line passing through the centers of these convolutions as the axis of the spring.

The greater the length L per given volume, the greater the number of turns (n), or spring units that can be formed per given maximum diameter of convolution, $2R$ or D. The increase in (n) gives a corresponding decrease in the deflection rate. The load P may be amplified by the value of R or l without changing the value of the economy index when keeping the cross-section and the volume constant, because then the deflection or "distance" component of the resilient energy is also amplified to the same extent. The load-deflection rate will vary as the first power of l in the latter case. Then again, a very wide sheet of spring material is inconvenient without modifying its form, which is done by cutting the material up into several parts or spring units and superimposing them as in leaf springs. As more fibers are stressed to a maximum value in this way, the economy index is increased, which means that for a large number of spring units (n), the load-deflection rate is decreased, which is just opposite to the reasoning for the helical and spiral forms.

Summary

Summing up the foregoing statements, it is found that for a given material the load-deflection rate or modulus of elasticity for the spring M depends upon the value of the economy index, which index in turn depends upon the average value to which the fibers in a volume of material are stressed. This average value is always less than a safe maximum value S, hence the economy index is always less than unity, i.e., the index value for pure tension. Considering only the form of section, the index is lower for a smaller moment of inertia, and smaller to a great extent for a rectangular moment (bending) than for a polar moment of inertia (twisting). The index is further increased by tapering the material, and by certain methods of loading. For a given length and volume, an increase in the diameter, or a decrease in the number of spring units of a coiled spring increases the load-deflection rate but not the economy index, while an increase in the number of spring units in leaf springs decreases the load deflection rate and will increase the economy index. For different materials and a constant economy index the resilient energy varies as the square of the maximum safe fiber stress, and inversely as the modulus of elasticity for the material.

Consequently, with these general fundamentals, the following general formula for springs has been derived, the derivation of the two principal constants ψ and ϕ being covered in previous articles, with the exception of a few cases. Once the previous matter is read, it need not be referred to again; but that which follows is intended as a permanent guide for the design of springs in general.

General Spring Design

All springs whose elastic curves are mathematically determinant may be designed from the following two formulas:

$$\frac{F}{P} = \frac{\psi}{E} \times \left(\frac{l}{d}\right)^3 \times \frac{1}{b} \qquad (1)$$

$$\frac{F}{l}\Big/\frac{l}{d} < \phi \frac{S}{E} \qquad (2)$$

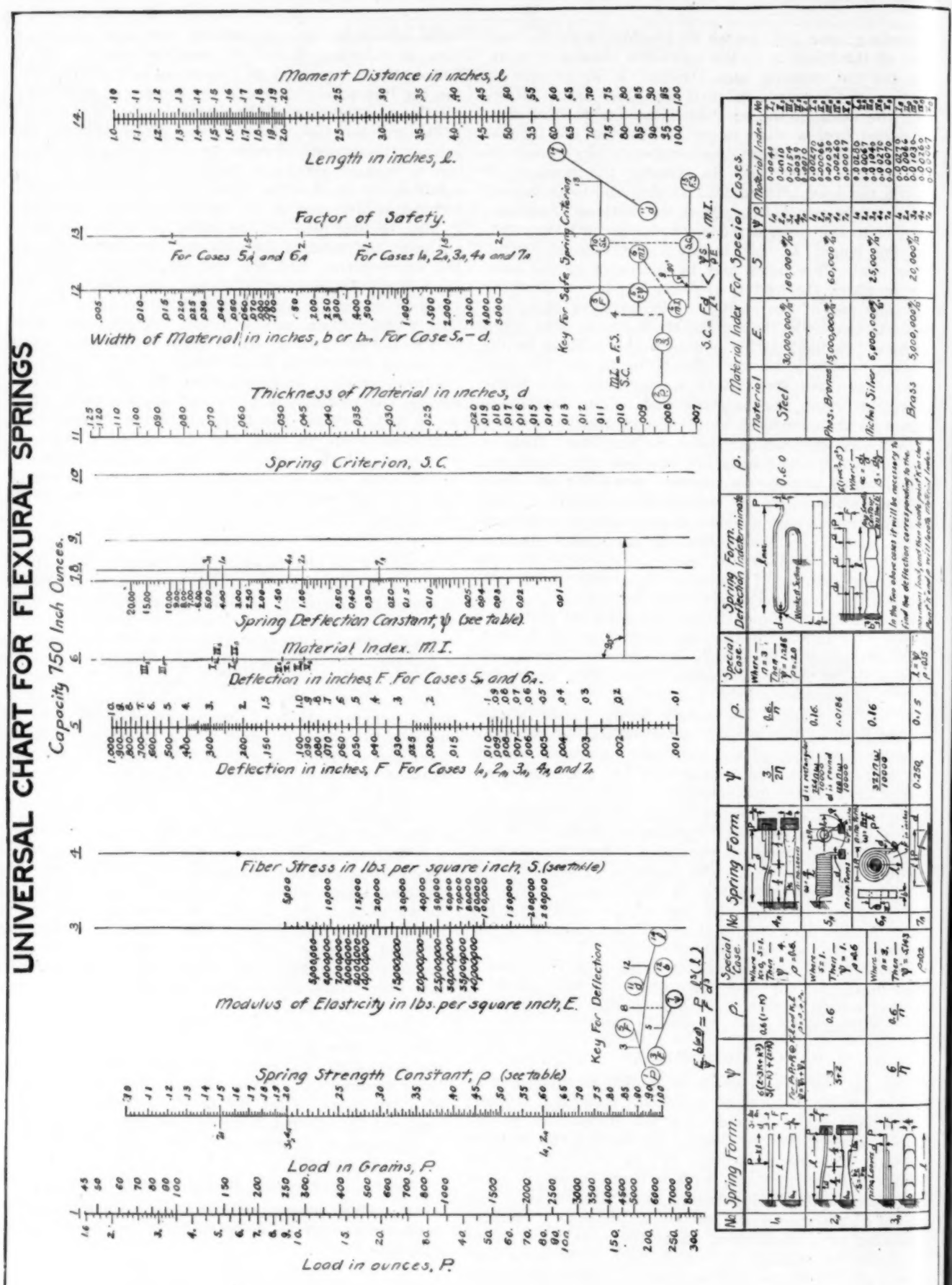

UNIVERSAL CHART FOR FLEXURAL SPRINGS
Moment Distance in inches, l
Length in inches, L.
Factor of Safety.
For Cases 5a and 6a
For Cases 1a, 2a, 3a, 4a and 7a
Key For Safe Spring Criterion
S.C. = F.S. × M.I.
Width of Material in inches, b or t_m For Case 5a – d.
Thickness of Material in inches, d
Spring Criterion, S.C.
Capacity 750 Inch Ounces.
Spring Deflection Constant, ψ (see table).
Material Index. M.I.
Deflection in inches F For Cases 5a and 6a.
Deflection in inches, F For Cases 1a, 2a, 3a, 4a and 7a
Fiber Stress in lbs. per square inch, S. (see table)
Modulus of Elasticity in lbs. per square inch, E.
Key For Deflection
Spring Strength Constant, ρ (see table)
Load in Grams, P.
Load in ounces, P.
Material Index For Special Cases.
Material
Steel
Phos. Bronze
Nickel Silver
Brass
Spring Form
Deflection Indeterminate
Special Case.

FIG. 3. UNIVERSAL CHART FOR COMPUTING SMALL SPRINGS

Formula (1) is the general load-deflection rate formula, in which the symbols have the following meanings:

$\frac{F}{P}$ is a measure of the load-deflection rate, F being the deflection in inches measured along the path described by the load or force P in pounds. The load-deflection rate or the modulus of elasticity for the spring M, as it may be called, is inversely proportional to the modulus of elasticity for the material E_T.

$\frac{l}{d}$ is cubed in the formula, and for this reason a small change in it will produce a large change in the load-deflection rate. This ratio, which can be called the spring index, consists of the distance l in inches, which is the normal distance from the fixed point of a spring to the point of application of the load. The fixed point of a spring lies in the spring axis, which is shown for all spring forms in Fig. 2. The symbol d represents the dimension in inches of the cross-section of the material which is perpendicular to the neutral plane in the case of bending, and which is a maximum in the case of twisting. This dimension is shown for different sections in Fig. 1.

In the formula, l is cubed for the following three reasons: (1) for increasing the length of the volume of material, which unaffects the economy index but increases the load-deflection rate; (2) for increasing the volume, which increases the load-deflection rate; and (3) for amplifying the load P, which increases the load deflection rate. The reason d is cubed is due entirely to its derivation from the moment of inertia of the section, and a small increase in d means a large increase in the cube of d and consequently a large decrease in the load-deflection rate.

A uniform decrease in the l's of the spring units (conical-helical springs) means an increase in the economy index or a decrease in the load-deflection rate. In this case, the l in the formula is the maximum l.

In $\frac{1}{b}$, the symbol b is the dimension in inches of the cross-section, perpendicular to d. A uniform decrease in b, as in tapered springs, gives an increase in the load-deflection rate. In the latter case b in the formula is the maximum dimension.

E_T is the modulus of elasticity for tension in pounds per square inch for cases of bending, and is also the modulus of elasticity for tension for cases of twisting. In the constants given in the table for the spring forms of the twisting type the constant $\frac{5}{2}$ is included in ψ, $\frac{5}{4}$ in ϕ and $\frac{5}{8}$ in U; which is based upon the assumption that E_G for torsion is equal to $\frac{2}{5} E_T$ for tension, and S for torsion is equal to $\frac{S}{2}$ for tension. This is done in order to bring the different spring forms down to a comparative basis. For accurate results the exact E_G of the material should be used.

The value of ψ is the means by which we may compare the relative load-deflection rates of the different spring forms in order to satisfy requirements (1) and (2) given in the first part of this article. The constant ψ which is always a pure number is made of several component parts which vary with the economy index U. The components are (1) Geometrical shape; (2) method of stressing (bending or twisting); (3) number of spring units; (4) variation in dimension l, b and d (very rarely, because not commercial) for any one spring. The values of ψ for all springs are given in Fig. 1, and the illustrations of the corresponding spring forms are given in the table for the chart, which will be described later.

Formula (2) is the spring criterion formula, which shows how the various dimensions of a spring for a certain deflection are limited by the material index, in order that the spring may safely be designed for the material selected and the service conditions. The symbols have the same meaning as in formula (1) but are grouped as follows:

$\frac{l}{d}$ is not cubed as in formula (1), its exponent being of the first power. It is well to note, however, that there is another l in the formula, but which is separated for reasons made obvious later in this article.

The ratio $\frac{F}{l}$ is important, because F is always measured at the end of l opposite to its end at the spring axis, and where the load P acts.

$\frac{S}{E_T}$ when multiplied by ϕ is called the Material Index. $\frac{S}{E_T}$ depends entirely on the material used and the ability of the material to withstand service conditions.

ϕ is the Material Index constant, which shows comparatively how much each form of spring may be safely deflected for equal spring dimensions and for the same material.

Fig. 1 gives the values of the constants ψ, ϕ and also U, the economy index, for each method of stressing except method (c) or combination bending and twisting, covering all spring and cross-section forms, each loaded in various ways. This table is useful in that it shows at a glance, for any one material, which type of spring gives the desired load-deflection rate and at the same time suits the particular space to which the spring is to be fitted. It also shows the extent to which the spring may be worked safely. The economy index U will give the comparative amount of resilient energy per volume that may be obtained from the different types of springs. It is suggested here that a unit of measurement of resilient energy be created for use in spring design, and be defined as follows: a "resilient" is equal to the work required to deflect a spring 1 in. by a load of 1 pound. Hence if it required a load of 10 lb. to deflect a spring 1 in., its maximum allowable amount, then the capacity of the spring would be equal to $PF \div 2 = (10 \times 1) \div 2 = 5$ "resilients."

Now, so far we have only two formulas and a table to keep in mind to cover the whole matter of spring design. The computation work involved in the determination of the constants shown in the table is very simple, but for the two general formulas it is quite considerable.

Parallel-Scale Chart

Hence a parallel-scale chart, shown in Fig. 3, has been prepared in order to facilitate the computation of the two general spring formulas for small springs of a capacity up to about 47 "resilients" or 750 inch-ounces. The parallel lines are numbered at the top and the scales on them are named according to that symbol in the general formulas which they represent. Special attention is called to the scale on line 7 on which the

value of the constant ψ is located. As the constant ϕ of the material index in the spring criterion formula is equal to $\frac{\psi}{\rho}$, ρ being the constant taken from the load-stress relation, only the ρ scale is provided on line 2 and the corresponding ϕ is determined by an operation on the chart. This was done simply for convenience in using the chart. The ψ and ρ values for the various types of springs are given in the table below the parallel lines. As space is limited, only springs of the bending or flexural order are given, and hence the chart is called the "Universal Chart for Flexural Springs." However, by applying the proper values of the constants ψ and ρ, which latter $= \frac{\psi}{\phi}$, the springs of the twisted order may be designed by means of this chart.

In Fig. 1 the small numbers, such as 1_A and 2_A, in the upper left-hand corners of the boxes mean that the illustration of the type of spring which the constants in a particular box represent may be found in that part of the chart table, Fig. 3, numbered similarly. The chart table also gives a method by which springs whose elastic curves are mathematically indeterminant, that is, those which have no load-deflection formula, may be designed within safe limits, provided that the load-deflection rate is determined beforehand by experiment. Finally, the chart table gives special values of E and S for certain materials and the corresponding values of the material index for the types of spring shown. The material index values are also located on the material index, line (6), which considerably shortens the work in using the chart. However, these special values of S and E should not be used unless they actually represent the material contemplated for use in the design of a spring.

In manipulating the chart, the two keys shown thereon are used in the following manner: The values of the symbols shown in the circles of these keys are joined together with a straight line, and this line is then intersected on the line indicated by its designating number. These intersections are joined as indicated, the extremities of a broken line being considered as two coincident points. The numbers in the circles correspond to the number of the line on which the scale of the associated symbol is located. In going from line 6 through line 10 to line 13, it will be noted that the computing line is drawn perpendicularly to an intermediate line 9 as indicated, and from this intersection a straight line is drawn through the desired values on lines 10 and 13.

Up to this point we have covered general spring design by two principal formulas. Inasmuch as ordinary helical springs (twisting) of both the extension and depression type are the most common type of springs used, a slightly different method of design was devised and presented in the article by the author on page 628, Vol. 54, of the *American Machinist*. The only other diversion from the general spring design method will be used in the case of eliptical springs, which, due to their extensive use in the automobile industry, should be treated in a special manner.

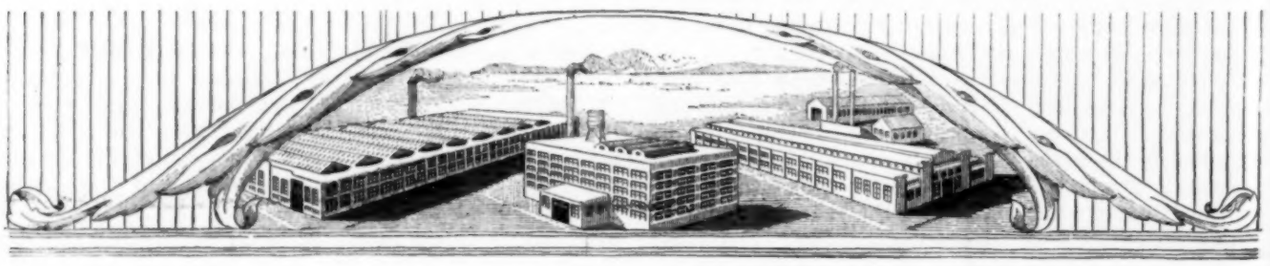
The values of S and E should accurately represent the material contemplated for use in the spring being designed by the formulas. In formula (1) only E appears, in which it varies inversely as the load-deflection rate. For any one spring only a change in E (and not S) will change the load-deflection rate; but formula (2) will show that the allowable deflection F (not the load-deflection rate $\frac{F}{P}$) will be limited by the value S directly and inversely by E, i.e., by the material index of the metal used.

It happens that the value of E for any one material remains practically constant under all conditions, while the value of S will vary considerably due to many conditions. The values of S and E and, consequently, the material index depend upon certain factors to the following extent:

	E	S
1—Major constituent of material	Mainly	Mainly
2—Chemical impurities	Slightly	Considerably
3—Chemico-physico unequilibrium		
3.1—Hot working	Slightly	Considerably
3.2—Cold working	Slightly	Considerably
3.21—Direction of rolling in flat material	Very little	Little
3.3—Heat-treatment	Very little	Considerably
3.4—Relative size of cross-section		
3.41—Large	Slightly	Considerably
3.42—Small	Slightly	Considerably
4—Electroplating of material (Fe):		
4.1—Cleaning in acid / 4.2—Electroplating (Occlusion of Hydrogen)	None	Possibly
5—Corrosion (indirectly on 4)	None	Possibly
6—Fatigue		
6.1—"Endurance Limit" below proportional limit	None	Considerably
6.11—Condition of outer surface	None	Considerably
6.12—Homogenity of material	None	Considerably
6.2—"Endurance Limit" above proportional limit	None	None
7—Under constant high temperature	Appreciably	Considerably

The principal materials used for springs are steel music wire, alloy steels, phosphor-bronze, and nickel silver, the overall range of S being about 15,000 to 200,000 lb. per square inch, and of E being about 5,000,000 to 35,000,000 lb. per square inch.

Future work will be required to bring out the limitations and approximations of the formulas used. The previous articles brought out the fact that in the derivation of every deflection formula some approximations were made, which cause inappreciable errors for moderate deflections, but are of a large magnitude for large deflections. The methods for determining E and S for bending and twisting may be made the subject of a future article.



Stimulating Business Revival

An Address by James H. McGraw, President, McGraw-Hill Co., Inc., New York, Before the Annual Convention of the Associated Business Papers, Inc.

THERE are two great classes in the world today—those who look on the world in chaos and see no hope for the future and those to whom the world disaster is but an inspiration for greater effort. I am putting the business papers in the latter class.

Someone has pointed out that there are people who liken existence to life in a squirrel cage—eternal movement and eternal sameness—but the leader of today is the man looking straight ahead with new thoughts or with new vision of old thoughts. The business publisher must grapple with the great problems before him with new thought and new vision of world conditions confronting him in order that they might be solved and harnessed for the welfare of humanity.

Let us picture these world conditions for the moment.

The European Crisis

Across the Atlantic the financial systems of Central Europe are going down in a horrible crash. The Austrian kronen and the German mark sell at 1/300 and 1/50, respectively, of their gold value, and since there is no such thing as isolation in the economic world, we, innocent of the cause, must share the burden with Europe.

Germany is in the throes of another cabinet crisis, with the danger of losing the gains of some eighteen months of political peace.

Russia daily slips deeper into the slough of economic dissolution—though possibly the deeper she goes, the quicker will come the day when her 180,000,000 people will again buy from the outside world—a buying, by the way, essential to a normal world functioning.

Petty wars still wage in Europe, despite the normal advent of peace three years ago.

American Conditions

Such, in brief, is the situation in Europe. In America conditions are more hopeful.

We have a tremendously improved banking and credit situation and plentiful evidences that we have passed the low point in the curve.

The oncoming disarmament conference has awakened the hopes of the world in the possibility of turning into productive lines millions of treasure that go into armaments. The disarmament conference deserves emphasis, too, because it is one of the biggest business conferences ever held. It will discuss reduction of armaments, but before it proceeds to that theme it must first settle the terms on which America and all other nations shall do business with China. The center of possible world disturbance has shifted from Central Europe to the Pacific, and there, let us hope, under the American standard of equal opportunity for all, will be waged the friendly war of honorable business competition, instead of the bloody wars which are sure to be consequent upon greedy exploitation and land seizure.

While, however, there are bright spots in the American business firmament, there are also heavy clouds. Right before us looms a nation-wide railroad strike. When the cloud has dissipated, or after it has been weathered, we shall probably find ourselves hard up against a strike in the bituminous coal-mining fields, for, while the operators are ready to agree to arbitration in settling the wage scales which come up for renewal on March 1, the coal miners are unwilling to give up the strike weapon.

Quite disturbing, too, is the fact that 4,000,000 of our people who want to work to make the goods and build the houses necessary to make up for our war depletion and shortage, are unable to work, and between 10 and 20 per cent of them are either in want now or will be with the advent of cold weather. While this in itself is disturbing, far more important is the evidence it affords of our failure to have developed the sound social system, in which the functioning of industry must necessarily prove an integral part.

Business is stagnant, yet the dallying Congress, imitating Nero, plays the fiddle of back-home politics while business goes to pot. The tax bill languishes on Capitol Hill. The tariff measure, universally condemned, has been shelved, casting just so much added doubt upon the business future. The railroad refunding bill makes no progress. All that could stabilize business and restore confidence is neglected, despite the urgings of an administration that displays a gratifying amount of business sense.

Interpreting the Situation to Business

Such are some of the features of a world situation unprecedented in complexity, in difficulties and in the number of discouraging features.

Each and every one of the situations referred to has a present-day bearing on American business. What is more, some of them will determine how America is to do business for many years in the future. If American business is to function up to the new position that has come to it during the war, and that necessarily flows from the fact that the center of world finance and of world influence has shifted to our shores, these governing conditions must be interpreted in terms of their influence on every industry. We may become, if we have but the knowledge, the foresight, and the energy, what England has long been—the market center of the world. But we can take this position only if we have a race of business men equal to the occasion—a race worthy of a world-wide commercial dynasty.

How shall American business men get this conception, how shall they rise to this opportunity unless the business press carries the message to them in each issue, strong with knowledge of the situation and its bearing on American business, convincing in the wisdom of the remedies it suggests, invincible in the enthusiasm and courage it displays?

It is no job for weaklings, but for the broadest-gaged man that the country commands. It will not be accomplished by editors chained to their desks, nor by mere reporters, nor by publishers who are bearish on America's future. It can only be accomplished by broad vision and the gospel of work.

As to European and other world factors which bear on American business, there must be a wise policy

carried home constantly by the business press. We must help mobilize American opinion on the stabilization of European currencies. We must not be squeamish in manfully demanding whatever re-arrangement of the German reparations may be necessary for the stabilization in Germany—realizing that a stable Germany is essential to a normally functioning economic world. When Russia comes back, as she must, when the other weakened powers are in a position again to buy in normal quantities, the business press must picture the opportunity and be the apostle of whatever credit structure is necessary to bring these nations again into the world economic family.

Likewise, as to every other factor in the European and the world situation, business papers must arise to the occasion and see to it that American business has a wise and courageous policy.

This task of interpreting world conditions to American business is not an easy one, yet it is only part of the great job which American business paper editors and publishers must do. We must necessarily be concerned with the affairs of the world, but naturally our first responsibility is for our own country, for our own industrial, economic and social conditions. Studying the problems that are closer to home, we find many avenues along which business papers can work in speeding the revival of business.

Waste and Extravagance Products of War

War breeds extravagance. In spite of the noble ideals which inspired this nation to take up the great conflict across the seas, the inevitable result was the accumulation of innumerable wastes and habits of extravagance. We became wasteful of our time, our money, materials and even life itself. We could not help it, but we can and we must overcome the habits and tendencies which were developed throughout our entire social and industrial fabric by that terrible conflict.

As a tangible example of what can be done, Herbert Hoover, has focused the attention of industry upon the unnecessary wastes which are sapping the vitality and reducing the productivity of our nation.

We are appalled when our attention is called to criminal wastes of life through accidents and negligence, the prodigal waste of our natural resources through under development or political chicanery, the prodigious waste of materials through mismanagement and inefficiency. But of all wastes which affect our happiness and prosperity, the waste of time and human effort is the greatest and has the most damaging influence.

If the business papers collectively and individually can instill into the minds of the thinking men of industry the gospel of intelligent work, we will have performed a tremendous service.

I will not attempt to recount all of the factors which enter into the problem of adjustment which is before us. But I do want to bring a thought before you, which is given in the words of Thomas Hughes:

"Who has the clearest and intensest vision of what is at issue in the great battle of life, and who quits himself in it most manfully, will be the first to acknowledge that for him there has been no approach to victory except by the faithful doing day by day of the work which lay at his own threshold."—I repeat the last clause, "except by the faithful doing day by day of the work which lay at his own threshold."

In brief, I bring to you as leaders of thought among thinking men that what this country needs more than anything else is to learn anew the gospel of work.

Intelligent work, untiring work, work in its most homely sense.

We cannot talk ourselves into prosperity. We cannot argue ourselves into stability, but we can work ourselves out of the valley of depression and up to the heights of plenty. We can do these three things.

First, everybody get busy at his present task, and make the most of it.

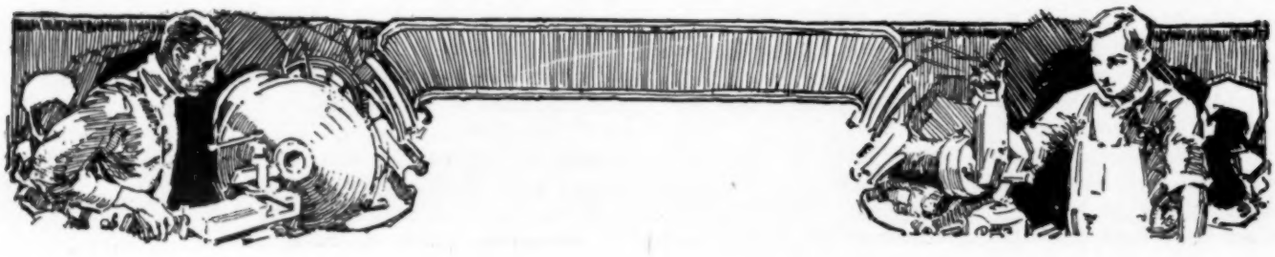
Second, everybody consider winning the peace in the same spirit as characterized the winning of the war.

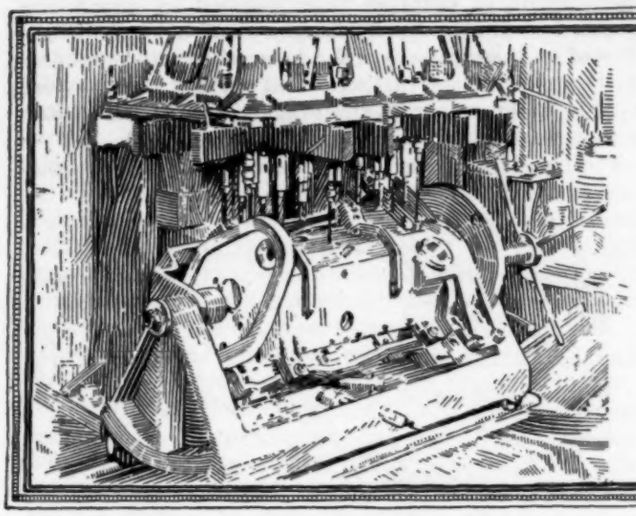
Third, the business papers, by article, editorial and personal service, show that selfishness has now no more place in war time. That interest in the welfare of all men, individually and as society, lies at the basis of prosperity.

In conclusion, let me say we must consecrate ourselves to giving a full measure of the best service we have within us. As a nation, and as publishers, we must quit our petty quarrels and arguments and devote ourselves to the tasks that lie before us. We had to **fight** and **destroy** to win the war. We will have to **work** and **build** to win the peace. The first nation that gets hold of the idea that only salvation comes from work will come out on top and really win the peace.

Demand for Trucks in Borneo

The British Chamber of Commerce for the Netherlands, East Indies, reports in *Eastern Engineering* that, as a result of the rapid development of Northeast Borneo, the volume of freight is growing. Several good roads have been constructed and the projected railway from Pontianak to Sambas will afford very much needed transport facilities. The market, actual and potential, for commercial motor vehicles is particularly worthy of exploitation, and it is stated that there is an ever-present demand in Northwest Borneo for the 3- to 5-ton type of vehicle. The projected railway can hardly absorb all the traffic which now uses the roads, and the estates will require transport for their produce to the nearest railway. The making of good roads and the facilities with which motor trucks can handle plantation produce have already led to a rapid increase in the numbers of commercial vehicles used.





Tool Engineering

By
Albert A. Dowd and Frank W. Curtis
President and Chief Engineer
Albert A. Dowd Engineering Co., New York City

Design of Second-Operation Turret-Lathe Fixtures Continued—Standard Face Plate as a Fixture—Fixture for Different Sizes of Work—Chuck for an Eccentric Casting

IN APPLYING the principle of the floating-scroll lathe chuck to the handling of work which has been previously machined, the nature of the work must be carefully considered. The portions which are to be held by the chuck jaws may be finished or in the rough. If in the rough, there may be considerable variation which might not be taken care of by ⅛-in. float in the scroll. If, however, the work is located for a previous operation by surfaces approximating those which are to be used for the second holding, then in all probability the amount of float mentioned will be sufficient to take care of variations. It is advisable wherever possible to grip the work by a previously finished surface, which will naturally be approximately concentric with the other portions. When this is done, there is little chance for trouble, and satisfactory results can be obtained without difficulty. Fig. 245 shows a piece of work *A* which is to be machined at *B*, *C* and *D*. The piece has been previously finished in the hole *E* and it has been faced and turned at *F*, *G* and *H*. Due to the fact that the entire casting is somewhat fragile in construction, it might easily vibrate considerably unless so held as to eliminate any trouble of this kind.

A locating bushing *K* is fitted to the center hole

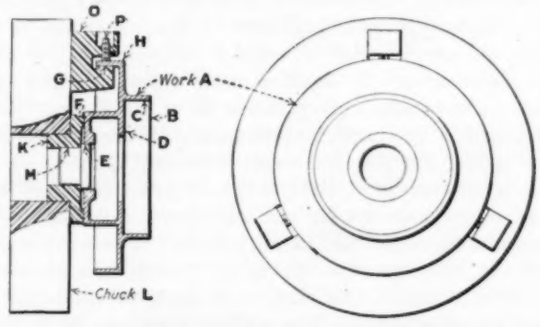


FIG. 245. APPLICATION OF A FLOATING SCROLL CHUCK

in the chuck *L*, as shown. This bushing has a flange on which the work rests at *F*, and it is also fitted with a plug *M* which enters the hole *E* in the work. Special jaws *O* are so arranged that they grip the thin flange in three places on the inside at *C*, the float of the scroll allowing them to adjust themselves to any slight variations in concentricity. These jaws are not strictly used for centering the work, but only for holding it to prevent vibration. Therefore they should not be brought up tightly, but only with sufficient pressure to make

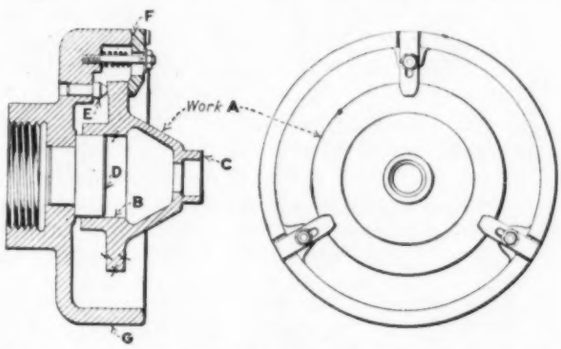


FIG. 246. SECOND-OPERATION FIXTURE FOR A MALLEABLE-IRON FLANGE

sure of a contact. After this is done, the setscrews *P* are tightened with a socket wrench, thus obtaining a metal-to-metal contact which gives an excellent drive for the work and prevents vibration.

The two examples given of the use of a floating scroll chuck are sufficient to illustrate its advantages. It should be noted, however, that any chuck in which the scroll ring has been refinished so that it will float, can not be used for centering and holding work of the ordinary kind.

Simple Fixture for a Flange

In Fig. 246 is shown a piece with a form somewhat similar to that just illustrated, but here the work *A* has been machined on the inside in a previous operation, and it is necessary to hold it by the portion *B* in order to machine the end *C*. This is another example of a fixture designed to be screwed directly to the end of the spindle, yet it could be mounted on an adapter if desired. The work locates on a plug *D* and rests on three hardened pins *E* in the body of the fixture. These pins strike against the finished surface of the flange and serve also to give correct end location to the work, so that the end *C* will be machined in a fixed relation to the

For the authors' forthcoming book.

flange, and will at the same time be concentric with the portion *B*. A simple method of clamping is used in this case, the clamps being shown at *F*. In order to keep the outside of the fixture clean and avoid trouble which might be caused by a projecting flange, the outer portion of the fixture is carried up in the form of a ring *G*, which is slotted to receive the ends of the clamps, as indicated. This is a type of fixture which is simple and efficient; and for other similar conditions the principles shown here can be applied.

In Fig. 247 is shown another method which can be used to grip and drive work that has been previously machined, and that is located in a central position by means of a plug or ring in a previously finished hole. The work *A* has been machined at *B*, *C*, *D* and *E* prior to the operation indicated. It is necessary to locate it by the inside surface *B* and by the end *C*. The work to be done in this operation is the facing of the surface *F* and the machining of the portion at *G* and *H*.

A standard faceplate *K* is used for the work. It is fitted with a locating ring *L* on which the work is placed. There are four standard faceplate jaws *M* mounted in the slots on the faceplate. These jaws are

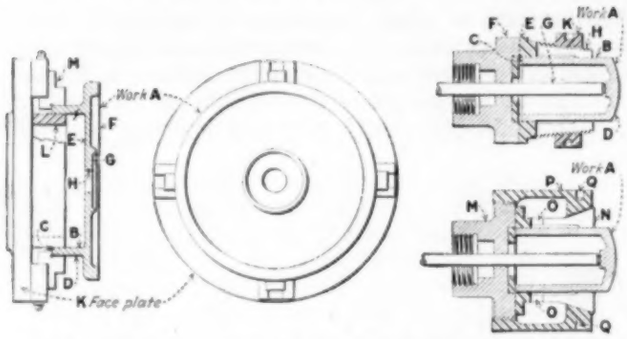


FIG. 247 (LEFT). STANDARD FACEPLATE USED AS A FIXTURE. FIG. 249 (RIGHT). SPECIAL COLLET CHUCK FOR LARGE WORK

cut out as shown, so that they will form an end stop for the portion *C* of the work. They also grip on the outside surface *D*. The standard jaws are operated independently by means of screws, so that they come up against the outer flange and hold it tightly against the locating ring. This method gives ample driving power so that the work can be held without danger of its moving under the action of the cutting tools. Another advantage is that the metal-to-metal method of gripping kills vibration and prevents chatter. The only objection to this scheme of holding is the fact that it is somewhat slow, as each one of the jaws is set up separately. It is, however, quite cheap and can be adapted to a number of conditions of a similar kind.

Fixture for a Ball Pipe Joint

When work of a spherical nature is to be held, considerable care must be used in the design of the fixture. In the first place, the seat on which the spherical portion rests must be formed out so that it will fit the work closely. In the example shown in Fig. 248 the work *A* has been previously finished on the spherical end. The other end *B* is to be faced at *C* and *D* in the operation shown. A fixture *F* is mounted on the adapter *E* and provided with four inserted jaws *C*. These jaws are wide enough so that they each have a contact of about 60 deg. on the outside of the spherical portion of the work, which they are bored out accurately to fit. The fixture *F* contains four toggles *H* which are mounted on pins at *K*. There is a small amount of float allowed on these pins in order to equalize any roughness on the inside of the casting. Coil springs are provided at *L* in order to throw the toggles toward the center, so that the work can be removed when desired.

The bar *M* extends through the spindle and is oper-

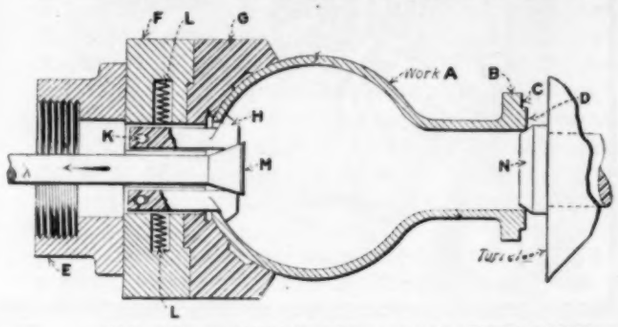


FIG. 248. FIXTURE FOR A BALL PIPE JOINT

ated by a handwheel at the rear end. When this bar is thrown back between the toggles the tapered portion forces these outward and at the same time pulls them back, so that they contact with the inside of the casting and hold it back firmly against its seat. In connection with this device it is necessary to use a centering plug, such as that shown at *N* in the turret. It is brought up and remains in the position shown while the clamps are being tightened, after which the turret is backed away and the tools used for the work operate in sequence. A centering device of this sort is often necessary when holding work during the operation of chucking.

There is an old saying that people learn more from their failures than they do from their successes. This is quite evident in tool work, for a man who has designed any kind of a mechanism which does not work properly and which gives trouble in operating, will be sure to hear about it in an unpleasant manner. If he is at fault in his design he will appreciate the trouble caused and will remember the conditions, so that he is unlikely to make the same error again. This is a costly method of learning how to do a thing correctly, and an example of a successful and an unsuccessful design is given herewith to bring out the point forcibly.

In Fig. 249 is shown a piece of work *A* which has been previously machined on the outside portion *B* and also at the end *C*. The curved end *D* is to be machined in this setting. A special form of spring collet *E* is mounted on an adapter *F* which is screwed to the spindle. The rod *G* is used as an ejector to force the work out of the chuck after it has been machined. This rod is operated by a collet mechanism at the end of the machine. The portion *H* is split in eight places, so as to allow it to spring as contracted by the nut *K*, which operates on the tapered thread. It was the intention of the designer to make this in such a way that by placing a pin in the holes shown, the collet would be contracted by the revolution of the ring according to its position on the tapered thread. The design however is faulty, and a great deal of trouble was experienced in operating it. It was practically impossible to contract the chuck sufficiently to hold the work and there was a great deal of friction on the threads, which doubtless had considerable to do with its faulty operation.

Another design, also shown, was made to take its place, the operation of the new device being perfectly

satisfactory. In this case the adapter *M* was fitted with a spring collet *N* having a tapered end. This collet was split in twelve places and large holes were drilled at *O* in order to give more spring to the collet jaws. The operating sleeve *P* was threaded to the adapter as indicated. In operating the device, the revolution of the sleeve *P* was accomplished by means of pins in the holes *Q*. The tapered portion caused the collet to contract and held the work rigidly. An ejector was provided similar to that shown in the other example. In this design a great deal of the friction which was caused by the tapered thread was overcome. The action was much smoother and the chuck was easier to operate.

When several pieces of the same general character but of different diameters are to be held in a fixture, it is sometimes possible to design this so that adjustments can be made to suit the various pieces. Even in cases when production is high, it might be advisable to follow this method and make up several fixtures of the same kind, adjusting them for the different pieces as required. By an arrangement of this sort the same patterns can be used for all of the fixtures; and the other parts, being uniformly designed, could be manufactured cheaper than if three or more fixtures all different and made from separate patterns were built.

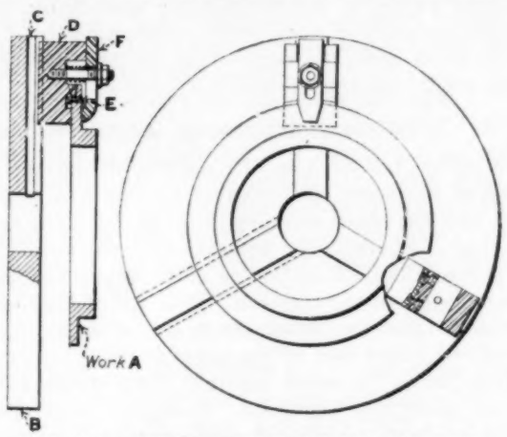


FIG. 250. SPECIAL FIXTURE FOR DIFFERENT SIZES OF WORK

An example of this kind is shown in Fig. 250. There were a number of pieces like the work shown at *A*, the pieces being practically the same except that their diameters varied considerably. A special faceplate *B* was made up and mounted on an adapter. It was slotted in three places, as shown at *C*. The slots were made up in T-form to receive keys, and the three jaws *D* could be adjusted readily in these slots to the diameters required for the different pieces of work. Several rings or grooves were scored on the face of the plate, so as to give the approximate position for each diameter required. The work to be handled is located in soft inserted jaws, shown at *E*. These jaws are bored out in place on the fixture, according to the diameter which is to be handled. The work is placed in these locating jaws and clamped in place by means of the sliding clamps *F*. The fixture is inexpensive and simple in design. It is often possible for the designer to effect substantial economies in the use of fixtures by a method similar to that shown; and therefore it is the part of wisdom to consider any pieces of similar character which are to be handled in the same general way, before proceeding with the design of the fixtures.

In setting up a piece of work which is to be turned eccentric to some previously finished surface or hole, care must be used in the design to make sure that the center of rotation is correct, in order to produce the desired results. The matter of location is important, and the method of clamping must be carefully studied, so that there will be no tendency to force the work out of position and thus produce an eccentric which is not in the right relation to the hole from which it is located. There are a number of ways in which an eccentric fixture can be made, but much depends upon the nature of the work and the degree of eccentricity required. Sometimes it is necessary to machine two surfaces in the same setting, and a fixture must be designed which can be indexed or thrown over from one position to another during the progress of the work. Fixtures of this kind will be discussed later.

The example shown in Fig. 251 is a piece of work *A* which has been finished at *B* in a previous operation. The end *C* has also been faced. It is necessary to machine the portions *D*, *E* and *F* and the interior surfaces *G*, *H* and *K* eccentric to the hole *B*. The fixture *L* is mounted on an adapter which screws on the end of the spindle. The locating plug *M* is placed eccentrically to the center of rotation of the fixture *N*. The portion to be machined is eccentric in the direction of the lug *O*, which thus provides a convenient method of locating the work. The arrangement used for the purpose consists of a pair of swinging arms *P* and *Q* operated by a screw bushing and bayonet-lock device, which has been previously described under the subject of drill jig design. The work is clamped in place by a large special clamp *R*, which straddles the hub and bears on both sides of it in line with the center of the work which is being machined. In considering the features of design brought out in this fixture, attention is called to the projecting screw at *S*. This would not be considered good design, unless some protection were provided so that the screw would not be likely to catch on the clothing of the operator. Provision should be made to prevent such an occurrence, by making a guard around the fixture, or using a piece of sheet metal fastened to it in such a way as to protect the end of the screw and yet leave it free so that a wrench can be applied without difficulty. The matter of protection to the operator

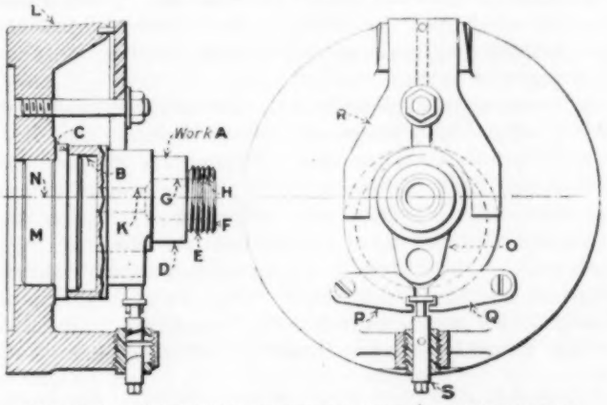


FIG. 251. CHUCKING FIXTURE FOR AN ECCENTRIC CASTING

should never be forgotten by the designer. Fixtures are usually improved as to their appearance also if care is taken to avoid all projecting lugs, clamps and screws. Furthermore, production is probably increased to some extent, because the operator is not afraid of being caught on any projections.

Artificial Seasoning of Steels

Review of Available Data on Length Changes and Spontaneous Generation of Heat in Hardened Steels—Results of Preliminary Experiments on Artificial Seasoning

By H. J. FRENCH*

THE fact that steels, under certain conditions of work and thermal treatments, undergo changes with time at ordinary atmospheric temperatures has long been known or suspected, and it has also been definitely established that these changes can be hastened by suitable heat-treatment or other artificial seasoning methods. Very little is known, however, regarding the nature of such changes, and there are relatively few publications available which deal with this question.

So-called tempering of hardened steels in hot water (aging) has long been used. While the discovery of the fact that hardening is effected by quenching from 100 deg. C. is credited to Langley and Metcalf[1] (1892), Hetzel[2] calls attention to earlier experimental work carried out along similar lines by H. Carron in 1872-73.

Schottky[3] has noted spontaneous generation of heat in hardened carbon steels when tempered at 100 deg. C., the magnitude of this effect apparently depending upon the carbon content and quenching temperature as well as on other factors.

Brush's Work on Heat Generation

Brush[4] has also shown that high-carbon tool-steel and chromium-tungsten "high-speed" steel spontaneously generate heat in appreciable quantity for at least several weeks after water-quenching from a high temperature and that the rate of generation steadily diminishes with time. Samples of hardened carbon tool-steel likewise shrank progressively when tempered to "straw color," to "light blue" and finally annealed, while after hardening, certain samples gave evidence of spontaneous shrinkage for many days in measurable amount. The behavior of these latter specimens was similar to that of the former in the gradual decrease in magnitude of the observed effect, which suggested a relationship between the two phenomena. Contraction was not considered the prime cause of the spontaneous heat generation, because calculations showed it to be inadequate in amount.

In more recent experiments carried out by Brush and Hadfield[5] specimens of a nickel-chromium steel behaved similarly when quenched from a temperature just above that of decalescence. The magnitude of the observed heat-effect was increased by a repeated treatment and persisted even when the specimen was heated for a third time and allowed to cool very slowly to a temperature where complete recovery of magnetic susceptibility was attained before quenching. Because of this anomaly further investigation by Brush, Hadfield and Main[6] was undertaken and some interesting facts were brought to light.

Attention is called to the fact that absorption of heat resulted from quenchings made at rising temperatures which generally had not previously been exceeded and that carbon tool-steel showed none of the eccentricities of the nickel-chromium steel when quenched below the hardening temperature; but when quenched above they behaved very much alike. It was also found that the rate of contraction of quenched steels followed the same law as the rate of evolution or absorption of heat which, after a short initial period, is approximately in inverse ratio to the time after quenching. It is generally considered that such contraction is due, at least in good part, to completion of the partly suppressed allotropic transformation.

Japanese Studies on Aging

Matsushita[7] has studied the nature of the slow contraction of hardened Krupp carbon steels and concludes that in well-hardened samples there is always a gradual contraction, whereas in imperfectly hardened steels there is a gradual elongation or an elongation associated with a subsequent contraction. It is stated that elongation results from the imperfect A_1 transformation, while contraction is ascribed to the separation of an unstable cementite from its solid solution (martensite) which does not affect the hardness. Complete separation of the first unstable carbide at room temperature requires several months or longer, while the same separation follows within two hours by heating the steel to 100 deg. C. The author also reports that the elongation or contraction of hardened steel is always accompanied by heat evolution.

Low elongation and reduction of area values have been noted by Reinhardt and Cutler[8] in tensile tests made immediately after heat-treatment and machining of test-bars taken from 5½-in. square steel billets containing 0.49 to 0.55 per cent carbon. Aging at room temperatures for twelve to twenty-four hours sometimes increased ductility more than 100 per cent, whereas similar beneficial effects were obtained in very much shorter time by heating to 120 deg. C. (248 deg. F.). Evidence is presented that complete restoration of ductility, which required about sixteen days at room temperatures, could be obtained at 120 deg. C. in twenty-five hours.

Honda and S. Saito[9] have recently studied the effects of two artificial seasoning treatments on the properties of K. S. magnet steel of the following composition:

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[1]Discussion of paper by A. M'Cance, "A Contribution to the Theory of Hardening," *J. I. & S. Inst.*, 1914. No. 1, p. 250.

[2]E. Hetzel, "Tempering in Hot Water," *Rev. Metal.*, vol. 12 (1915), p. 584.

[3]H. Schottky, "On a Thermometrically Recognizable Tempering of Quenched Steel at 100 deg. C.," *Ferrum*, vol. 10 (1912), p. 274.

[4]C. F. Brush, "Spontaneous Generation of Heat in Recently Hardended Steel," *Proc. Am. Phil. Soc.*, vol. 54 (1915), p. 154.

[5]C. F. Brush and Sir R. A. Hadfield, "Spontaneous Generation of Heat in Recently Hardened Steel," *Proc. Roy. Soc.* (London), vol. 93A (1917), p. 188.

[6]C. F. Brush Sir R. A. Hadfield and S. A. Main, "Further Experiments on Spontaneous Generation of Heat in Recently Hardened Steel," *Proc. Roy. Soc.* (London) (abstract), vol. 95 (1918), p. 120.

[7]T. Matsushita, "On the Slow Contraction of Hardened Carbon Steels" (abstract), *Proc. Tokyo Math.-Phys. Soc.*, vol. 9 (1917-18), p. 312.

[8]G. A. Reinhardt and H. L. Cutler, "Effect of Time and Low Temperature on Physical Properties of Medium-Carbon Steel," *Bull.* A.I.M.E., vol. 151 (1919), p. 1091.

[9]K. Honda and S. Saito, "On K. S. Magnet Steel," *Proc. Phys.-Math. Soc. Japan*, 3d series, vol. 2, No. 3, p. 32.

	Per Cent
Carbon	0.40— 0.80
Cobalt	30.0 —40.0
Tungsten	5.0 — 9.0
Chromium	1.5 — 3.0

Residual magnetism was not appreciably diminished by prolonged heating for 10-hour intervals at 100 deg. C. (212 deg. F.), while mechanical aging, carried out by dropping a bar 850 times on a concrete floor from a height of 1 m., decreased the magnetization by 6 per cent of its initial value.

Nature of Spontaneous Changes

Undoubtedly the spontaneous evolution of heat, dimensional changes and other observed effects such as have been described above are directly associated with the initial stresses and suppression of the transformations resulting from rapid cooling (quenching). As recently pointed out by Jeffries,[10] the presentation of an adequate explanation of such phenomena offers extraordinary difficulties. Admittedly an atomic rearrangement takes place in hardened steels at room temperature and because of the resistance of mechanical cohesion the time factor is pronounced.

If the character of the dimensional changes (contraction or elongation) occurring in quenched steels is dependent upon the adequacy of hardening as reported by Matsushita,[7] it would appear that for each steel there would be a critical time-temperature relationship in quenching which would at least decrease the magnitude of such changes, and investigation of this point might well be undertaken.

Stability of Gages

Dimensional changes with time are often encountered in hardened reference gages, and their magnitude and occurrence have been found to vary considerably in gages produced from the same materials under similar conditions of manufacture. In this case, where the steel is used as a standard of measurement, changes in length and planeness of the order of 0.00005 in., which ordinarily might be neglected, become of considerable importance, as do also the methods capable of hastening their completion.

During 1919, at the request of the Ordnance Department, U. S. A., a systematic investigation of the effects of seasoning of gage blocks was planned, using five steels already employed in the manufacture of gages or those which appeared to offer possibilities for such work. A large number of gages were produced and seasoned in various ways, following which changes in dimensions were noted over an extended period. While it is not possible to draw any definite general conclusions from the results obtained, it is believed that presentation of the following data will be of interest and possibly benefit those who may at some future time elect to investigate this subject, or perhaps it will bring to light existing information not yet published.

All gages used were prepared in the gage section of the Bureau of Standards, while the actual work in carrying out the various heat-treatments was performed by H. R. Yerger, formerly of the staff, who also planned the investigation in consultation with various members of the metallurgical division, gage section and optics division. C. G. Peters and assistants of the interferometry section of the last named division of the Bureau have carried out all the measurements for flatness and length of the gages as reported in this paper.

TABLE I. COMPOSITION OF STEELS TESTED

Code Letters	Chemical Composition, per Cent C	Mn	P	S	Si	Cr	Ni	W	V	Suggested for Investigation Because of
HC	0.96	0.35	0.014	0.017	0.25	1.31	0	....	..	Use for bearings requiring high hardness, permanence, wear, resistance, etc.
K	0.87	1.10	0.017	0.10	0.23	0.46	0	0.43	0.12	Avoidance of cracking and warping in hardening.
DR	1.18	0.20	0.016	0.013	0.21	0.08	0	....	....	High hardness obtainable in heat - treatment.
ST	0.29	0.36	0.009	0.014	0.70	13.20	0	....	....	Non-corrodible qualities.
DB	1.18	2.20	0.008	0.026	0.26	18.10	0	....	....	Non - deforming qualities and high cutting value.

TABLE II. HARDENING OF THE STEELS TESTED

Code Letters	Oil Quenched from Deg. C.	Deg. F.	Remarks
HC	850	1,562	Note.—Temperatures approximating those recommended by the manufacturer have been used.
K	800	1,472	
DR	800	1,472	
ST	955	1,751	
DB	955	1,751	

TABLE III. SEASONING TREATMENTS USED

Code Letter	Description of Treatment
A	No treatment after hardening.
B	Heated in oil 3 hr. at 100° C. (212° F.) and air-cooled.
C	Heated in oil 3 hr. at 150° C. (302° F.) and air-cooled.
D	Heated in oil 3 hr. at 200° C. (392° F.) and air-cooled.
E	10 alternate 5-minute dips in oil at 200° C. (392° F.), and water at 0 to −5° C. (32 to 23° F.)
F	80 alternate dips as for E above.
G	44 alternate dips of 3 minutes in gasoline at 35 to 20° C. (—31 to —4° F.) and 7 minutes in oil at 200° C. (392° F.).
H	Heated in oil 1 hr. at 275° C. (527° F.).
I	Heated in oil 4 hr. at 275° C. (527° F.).

Materials and Procedure

Five steels were chosen for the work on permanence as shown in Table I. They were received in the form of 1-in. hot-rolled rounds and were first annealed and then examined microscopically for excessive non-metallic inclusions and surface decarburization. As a result of this examination a few bars were discarded, while the remainder were machined and ground into rough gages. These latter were then hardened by heating in a lead bath (equipped with suitable pyrometric control) and quenched in oil. After grinding, the blocks were seasoned in various ways and the gages were then finished in accordance with the Hoke method.[11]

The hardening treatments used for the five steels are shown in Table II. Temperatures chosen are not very different from those ranges recommended by the manufacturers, though in one case preliminary quenching experiments were also carried out to determine what would be a suitable treatment. In selecting the various seasoning treatments listed in Table III, time and temperature variations as well as relatively rapid changes between temperatures above and below that of the room were considered important. The latter class of treatments may or may not involve a change in state depending upon the hardening conditions, whereas the former is considered to decrease the resistance of mechanical cohesion.

In making tests for planeness (flatness), the usual opticians' method of testing plane surfaces was used. Length tests were made by comparing the gages with the standard precision gages at the Bureau of Standards. The standard and unknown gage were brought into close contact with a plane glass surface and the difference in length was determined from the displace-

[10] Zay Jeffries, "Physical Changes in Iron and Steel Below the Thermal Critical Range," *Mining Met.* (Feb. 1920), vol. 158, section 20.

[11] H. L. VanKeuren, "Manufacture of Hoke Precision Gages at the Bureau of Standards," *Am. Mach.*, April 3, 1919, p. 625.

ment of the interference fringes occurring when a second glass plane was made to form wedge-shaped films of air over the upper surfaces of the gages, and the film illuminated by monochromatic light at nearly perpendicular incidence. This method for testing gages is described by Peters and Boyd.[12]

Importance of Early Observations

A summary of the results of these measurements over an extended period, together with records of Shore scleroscope hardness and intervals between date of hardening, first and last measurements, is given in Tables IV and V for each of the five steels under consideration. It would have been desirable to have the first measurement made on each gage on the day of seasoning, which in turn might have been carried out after a definite number of days from the day of hardening. However, this was not found possible on account of the number of operations and length of time required in finishing the blocks and because of the large number of measurements for length and planeness which would of necessity have to be made on any given day. A schedule approximating this procedure as closely as possible was therefore adhered to. Though others are perhaps not in agreement with this, the writer is of the opinion that under these conditions a very important period for studying permanence (the time immediately following the hardening and finishing of the gages) has, by force of circumstances, been neglected, assuming that the changes in any given short time interval (a few days or weeks) are within the limits of experimental error of measurement. That this assumption may be in error is indicated by the behavior of gages DB3 and DB4,

TABLE V. PLANENESS CHANGES IN ¼ INCH GAGES IN MILLIONTHS OF AN INCH

Steel	First Meas., No. of Days After Hardening	No. of Days Between First and Last Measurements	Ave. of 4 Gages	Max. of 4 Gages	Min. of 4 Gages
K	14	211	7	17	0
	8	227	29	58	5
	8	227	5	23	0
DR	8	227	13	69	0
	8	227	6	23	0
	8	227	8	34	0

which received no artificial seasoning treatments (treatment A Steel DB of Table IV). These gages, which up to the time of their fifth measurements had shown no change in surface, became so badly deformed during the period between their fifth and sixth measurements that they could not be made to adhere to the glass plate at the later date. It was found that the surfaces had become cup-shaped, the inner half being fairly plane, but sloping irregularly upward to the edges, the depth of the cup-shaped figure being from 0.0001 to 0.0002 in. for DB4 and from 0.0002 to 0.0005 in. for DB3.

The work of earlier investigators as briefly discussed

[12] C. G. Peters and H. S. Boyd, "The Calibration and Dimensional Changes of Precision Gage Blocks," *Am. Mach.*, Sept. 30 and Oct. 7, 1920.

TABLE IV. SUMMARY OF DIMENSIONAL CHANGES IN QUENCHED 2-IN. REFERENCE GAGES WITH AND WITHOUT SEASONING TREATMENTS AND SHORE HARDNESS VALUES

Each seasoning treatment was applied to 4 gages. Where no changes in length or planeness occurred equal to or greater than 0.00001 in., no figures are given.

Steel	Annealing	Hardening Heated in Lead Bath to	Treatment	—Seasoning Length Changes in Millionths of an Inch*— No. of Days After Hardening	No. of Days Between First and Last Measurements	Average of 4 Gages	Max. of 4 Gages	Min. of 4 Gages	Shore Hardness of Seasoned Gages Average of 4 Gages	Max. of 4 Gages	Min. of 4 Gages
HC	900° C. air-cooled then 800°C. furnace cooled	850° C. and oil quenched	A	..	..	..	..	..	93	95	92
			B	2	217	70	80	50	96	98	94
			C	2	217	17	20	10	92	95	89
			D	2	217	10	20	0	84	87	81
			E	2	217	7	20	0	90	92	84
			F	..	..	..	..	..	89	94	82
			G	13	245	—7	—20	0	86	90	80
			H	..	..	..	..	..	86	88	85
			I	..	..	..	..	..	84	85	81
K	830° C. air-cooled then 800°C. furnace cooled	800° C. and oil quenched	A	12	212	—140	180	0	85	88	83
			B	12	212	—2	—10	0	89	90	88
			C	..	..	..	..	..	88	91	83
			D	..	..	..	..	..	85	88	83
			E	..	..	..	..	..	87	88	85
			F	..	..	..	..	..	85	86	83
			G	14	216	—2	—10	0	78	85	75
			H	..	..	..	..	..	84	88	80
			I	..	..	..	..	..	86	87	85
ST	900° C. air-cooled then 800°C. furnace cooled	955° C. and oil quenched	A	16	212	5	10	—10	66	67	65
			B	16	212	17	30	—10	72	75	69
			C	16	212	12	20	0	68	69	67
			D	16	212	7	30	0	68	72	65
			E	..	..	..	..	..	70	73	68
			F	16	212	2	10	0	71	75	67
			G	13	220	10	20	0	64	68	60
			H	13	220	5	20	0	68	70	65
			I	13	220	12	30	0	65	70	60
DR	800° C. air-cooled, then 770°C. furnace cooled	800° C. and oil quenched	A	12	229	5	20	0	73	75	72
			B	12	229	5	20	0	78	85	70
			C	12	229	12	20	0	79	88	75
			D	12	229	5	20	0	79	85	73
			E	..	..	..	..	..	75	78	72
			F	..	..	..	..	..	80	83	76
			G	14	219	25	40	20	68	72	63
			H	14	219	22	30	20	71	72	70
			I	14	219	20	20	20	71	72	70
DB	900° C. air-cooled, then 880° C. furnace cooled	955° C. and oil quenched	A		(See note below)				66	70	60
			B	..	..	..	..	..	70	75	65
			C	..	..	..	..	..	84	88	80
			D	..	..	..	..	..	66	71	60
			E	..	..	..	..	..	75	85	65
			F	..	..	..	..	..	81	87	75
			G	..	..	..	..	..	70	75	65
			H	..	..	..	..	..	68	70	66
			I	..	..	..	..	..	73	75	70

* Negative signs before length changes refer to decrease; all other figures to an increase.

NOTE.—The 2-in. gages DB3 and DB4, subjected to treatment A, which showed no change in surface up to the time of the fifth measurements, became so badly deformed thereafter that no further measurements could be made, as detailed in the text. Attention is drawn to the fact that blocks of steel ST, DB and DR are in general considerably softer than those usually employed in production of gages. Blocks of steel HC and K are nearer the low limit of hardness generally used.

in the introduction further supports the writer's contention that early changes are more rapid than those occurring at a later date.

Conclusions

Based on total change from first to last measurements, the following conclusions may be drawn:

(*a*) The short gages (½ in.) showed no appreciable changes in length with or without artificial seasoning over a period of approximately seven months (first measurement one to two weeks after hardening). No appreciable changes in planeness occurred in the long gages (2 in.) with the exception of the two unseasoned blocks DB3 and DB4 mentioned above.

(*b*) Longer gages than those used (2 in.) would be more desirable for studying length changes with time, because of the extremely small variations actually occurring. About 6 to 8 in. is recommended.

(*c*) Variation in behavior of duplicate gages is confirmed by the K steel blocks subjected to no artificial seasoning treatment. One of these blocks showed no dimensional changes in 217 days between first and last measurements, while a duplicate decreased 0.00018 in. in the same period. Likewise duplicate artificially seasoned gages show differences as illustrated by steel ST, treatment D, Table IV.

(*d*) Except in the case of the plain carbon steel (DR) the changes in planeness are not appreciable.

(*e*) Gages produced from steels ST, DR and DB are softer than reference blocks ordinarily used. The latter are kept between about 90 to 100 Shore hardness. From this standopint, steel ST is unsatisfactory, as it is not possible with ordinary treatment to maintain the hardness within the limits described. A higher-carbon alloy of this type would be more desirable, with possibly a decrease in chromium content so as not to impair its stain resistance and at the same time reduce production costs.

(*f*) The plain-carbon steel DR (containing 1.18 per cent carbon) appears to be the least desirable from the standpoint of permanence, showing in the main the greatest changes in length and planeness during a period approximating seven months from first to last measurements. Probably the most desirable are steels HC and K subjected to definite seasoning treatments, the former being the steel generally used in production of reference gages at the Bureau of Standards and closely agreeing with the composition of Johanssen blocks.

(*g*) None of the seasoning treatments applied has been effective in preventing dimensional changes (within the limits of measurement) in all five steels. Also all seasoning treatments applied appear to effect permanence in Steel DB (containing 1.18 per cent C, 2.20 per cent Mn and 18.10 per cent Cr). Treatments H and I, however, have decreased the hardness.

Recommended Heat-Treatment

(*h*) Seasoning treatments E and F, consisting respectively of ten and eighty alternate 5-minute dips in oil at 200 deg. C. (392 deg. F.) and ice water at 0 to —5 deg. C. (32 to 23 deg. F.) are the most generally effective treatments tried for obtaining permanence. Probably less than eighty would in many instances suffice to bring the steel in a state of rest under conditions of treatment and manufacture as previously outlined.

Measurements made at intervals of approximately one and two weeks, one, two, four and seven months after initial readings of length and planeness do not give very much information regarding the progress of the changes taking place. Unsuitable steels exhibiting the greatest instability in either length or planeness appear to increase progressively in error with time. In many cases of more suitable steels possessing great constancy these changes seem to occur in the intervals immediately following the first measurement, the gages thereafter remaining constant. However, no very definite statements may be made in this respect.

Shrinkage in Steel

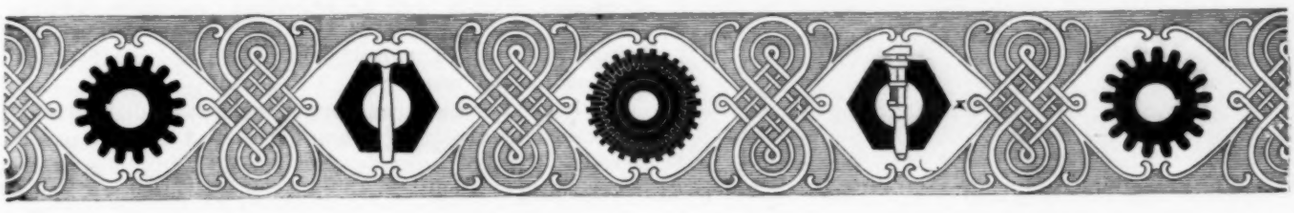
In a majority of the blocks examined showing dimensional changes there is an elongation, but in the case of steel K shrinkage only is observed. This is unusual, as the changes observed in hardened blocks are usually of the latter type—i.e., decrease in length. Four unseasoned gages produced from this latter material (containing 0.87 per cent C, 1.10 per cent Mn, 0.46 per cent Cr, 0.43 per cent W, 0.12 per cent V) will illustrate progressive shrinkage in hardened steel over an extended period. (Table VI.)

TABLE VI. PROGRESSIVE SHRINKAGE IN RECENTLY HARDENED STEEL

Chemical composition, per cent, C, 0.87; Mn, 1.10; Cr, 0.46; W, 0.43; V, 0.12.

Sample No.	Date of Measurement	Length in Inches	Shrinkage in Inches
K17	Sept. 8, 1919	1.89995	.....
	Sept. 25, 1919		0.00004
	Oct. 24, 1919		0.00007
	Dec. 26, 1919		0.00012
	April 7, 1920		0.00018
K18	Sept. 8, 1919	1.89996	.....
	Sept. 25, 1919		0.00002
	Oct. 24, 1919		0.00003
	Dec. 26, 1919		0.00006
	April 7, 1920		0.00008
K19	Sept. 8, 1919	1.89995	.....
	Sept. 25, 1919		0.00003
	Oct. 24, 1919		0.00005
	Dec. 26, 1919		0.00008
	April 7, 1920		0.00014
K20	Sept. 8, 1919	1.89996	.....
	Sept. 25, 1919		0.00004
	Oct. 24, 1919		0.00006
	Dec. 26, 1919		0.00011
	April 7, 1920		0.00016

No satisfactory explanation for such difference in behavior can be given at this time, but it is of interest to note that microscopic examination indicates more complete hardening of the K steel blocks (martensite-troostite throughout) than is obtained by oil-quenching the carbon-steel gages (DR) which show a less uniform structure consisting of troostite and sorbite at the surface and sorbite in the interior, indicating but local and partial suppression of the transformations and less complete hardening. In view of this fact the work of Matsushita[7] and his conclusions that the type of dimensional change (elongation or shrinkage) is related to the character of hardening becomes of particular interest.



Ideas From Practical Men

Devoted to the exchange of information on useful methods. Its scope includes all divisions of the machine building industry, from drafting room to shipping platform. The articles are made up from letters submitted from all over the world. Descriptions of methods or devices that have proved their value are carefully considered and those published are paid for.

Gear Tooth Rounding Attachment

By J. M. Henry

An ingenious device for rounding the ends of gear teeth to permit the gears to be meshed together while in motion, as is the case with automobile transmission gears, is shown in Figs. 1 and 2. It is designed to attach to the table of a No. 2 Pratt & Whitney milling machine and is complete in itself, requiring no movement of the machine to which it is attached save the rotative one of the cutter.

The body of the attachment is bolted firmly to the table of the miling machine, a tongue, fitting into the table groove, bringing it into alignment. The working parts are carried in a movable bracket fitted to slide in the body in a direction parallel to the longitudinal movement of the machine table.

The device is driven by a belt from an extra pulley on the countershaft of the machine and is entirely automatic in its action. By changing a single selective gear to match, gears having any number of teeth from ten to forty may be operated upon.

The gear to be worked is held centrally against the faceplate by means of an expanding stud, or arbor, projecting from the spindle of the device, and is positively located circumferentially and driven by the locating piece *A*, Fig. 1, which is adjustable radially upon the faceplate to accommodate different diameters of gears. Upon the other end of the spindle is keyed the selective gear *B*, Fig. 2, which must have the same number of teeth as the gear being worked.

The selective gear is driven directly by a worm located in the housing *C*, Fig. 2, which is adjustable vertically to accommodate different diameters of gears, and the worm is in turn driven from the pulley shaft through an adjustable train of tumbler gears which

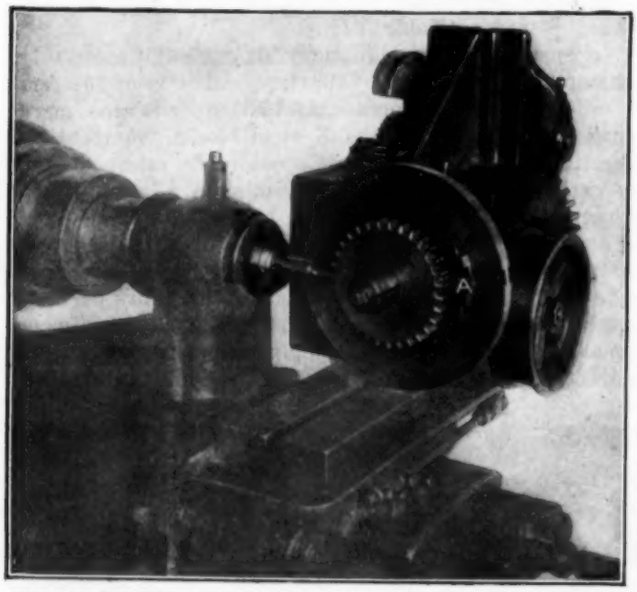


FIG. 1. DEVICE FOR ROUNDING ENDS OF GEAR TEETH

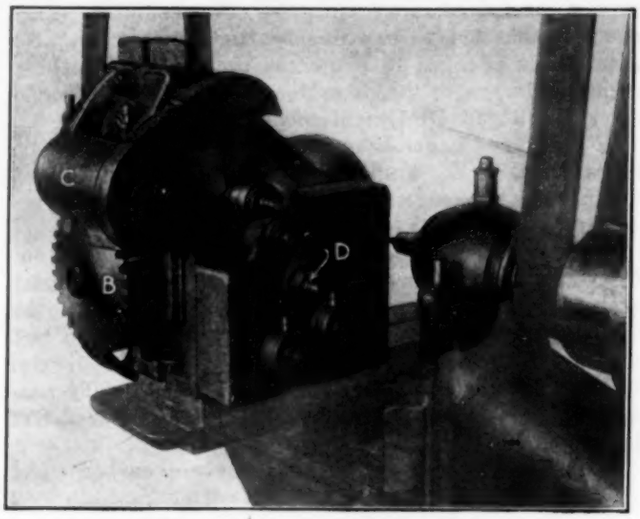


FIG. 2. REAR VIEW OF DEVICE

may be set to mesh in any position of the worm housing.

The pulley shaft drives, through suitable reduction gearing, a camshaft the rear end of which may be seen at *D* in Fig. 2. The cam upon this shaft advances the movable bracket of the device toward the cutter, the return movement being actuated by a spring so that there is one complete forward and back movement of the work for every tooth. The shape of the cam determines the shape of the end of the gear tooth and may be modified to meet requirements.

How to Machine the Brass Disk

By A. Harpham

Rugby, England

Referring to the inquiry on page 959, Vol. 54, of *American Machinist*, as to how a certain brass disk should be machined, I would say that the work should be done on a boring mill as follows: Soft jaws, previously turned in place on the mill should be used, leaving plenty of bearing surface and a shoulder about $\frac{1}{8}$ in. deep for gripping.

Operation No. 1: Grip the disk lightly by the periphery and finish the boss side all over, using disk lugs in the holes to do the driving.

Operation No. 2: A solid spigot plate bolted to the mill table should be used, which should be recessed to a depth of $\frac{1}{16}$ in. to fit the boss. This plate should have a $\frac{3}{4}$ in. tapped hole in the center and a bolt, with washer $3\frac{1}{2}$ in. in diameter, will serve to hold the disk flat. By using the driving lugs as before, no difficulty will be found in machining this side; the bolt and washer being removed to permit finishing the small space covered by the washer.

To machine the large tapped holes the disk should be located by the central hole on a stud and, by using a radial drill of suitable size, no difficulty should be experienced in drilling and tapping the holes.

Punch and Die Design

By J. H. Hemminger

Much has been written on the designing of punches and dies, but most of it seems to treat on construction. The writer will endeavor to describe a few important and often forgotten details in planning the systematic designing of dies.

The designer should always be given data concerning the style and number of presses available for making the part. This data should contain shearing capacity, stroke, adjustment and maximum or minimum closed die space for each press. Some designers ignore this data and as a consequence the work is poorly distributed, as some presses are heavily overloaded while others remain idle.

On receiving a detail of the part to be made the designer usually figures the number of operations necessary. Too often designers fail to investigate the function this part performs in final assembly. Extreme accuracy may be required in some places while wide allowances may be permissible in others.

A data sheet of bolsters, die shoes, and punch holders should be given the designer. The bolster data should give size and shape of opening in each bolster, and the location of die shoe bolt holes. I have seen cases in which too small a die shoe has been used for the prescribed press bolster opening, and at other times the bolster opening has been too small for the spring or rubber bumper clearance.

Some drawings of punches and dies reach the toolroom with data regarding everything but the information as to what operation they are to perform, also the condition of the material before reaching the die and the condition in which it should leave the die. In giving the toolmaker this oft forgotten information he is better able to see and plan his objective. In the case of forming dies some designers will draw the position of the part in the die after forming, but ignore the information regarding the piece before it comes to the die, leaving this part for the toolmaker to figure out to the best of his ability.

The usual sectional view of punches and dies if drawn in the closed position, will clearly show if there

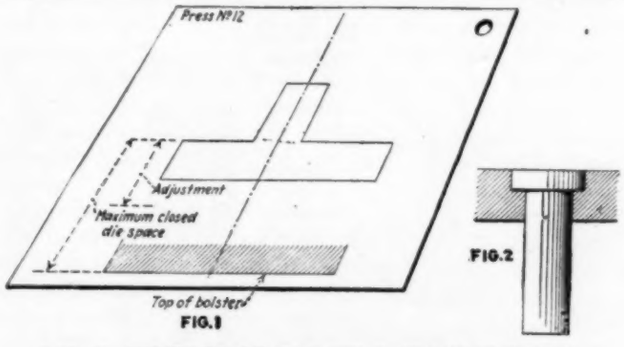


FIG. 1. TEMPLET OF DIE OPENINGS IN PROCESS
FIG. 2. SHOULDERED PUNCH SHANK

are any interferences or not sufficient clearance, or if the prescribed press will take the die.

In designing a large number of dies it is good practice to have die shoes and punch holders printed on drawing paper in their relative press positions. If this is not done a good way of checking the die space with the prescribed press is to make a checking templet, as shown in Fig. 1, out of transparent celluloid. This templet can be used for checking all future dies for that press and will show if any discrepancies exist to prevent successful operation.

If in placing shouldered punches in a punch plate, as shown in Fig. 2, consideration be given to the counterbore sizes available in the shop, it would mean a saving of time as well as a convenience to the toolmaker.

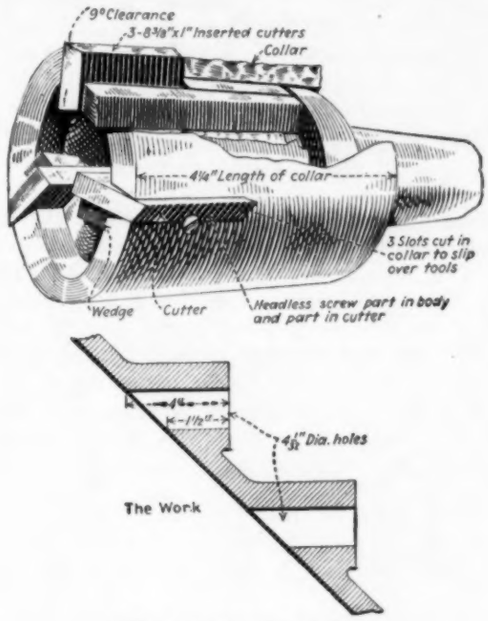
A Special Boring Head

By P. S. Klick

Recently we had some conical bronze tube sheets, about 13 ft. in diameter with over five hundred 4 25/32-in. reamed holes to machine.

The cored holes measured 3½ in. and we had the usual fins, sand and hard scale to contend with. Moreover, most of the cores were not straight.

To rough the holes out, we made a tool as shown in the sketch. As soon as the three inserted tools began



SPECIAL BORING HEAD

to cut to size, the slip collar followed in the hole, and helped to guide the tool straight. By the time the intermittent cut began the collar had a bearing of 1½ in. The slots in the collar also helped to support the cutting edges of the tools. The collar was removed when tools had to be sharpened. About 3/16 in. was left for the finishing reamer, and very good time was made on heavy radial drilling machines. Water and Oakite were used as a coolant.

Extend the Use of Commercial Diamonds

By C. J. Arthur

It is surprising that diamonds are not put to more general use in the shop. Carbons and splints are in service for truing grinding wheels and an occasional diamond turning tool may be seen, but in very few plants are diamonds put to work in as many ways as could be done to great advantage.

It is not much of a trick to mount and grind commercial diamonds, but my experience has taught me that in most cases it is more profitable to call upon the companies specializing in this work to furnish the diamond mounted and ground to the desired shape. In a few instances it may be necessary to true or square

up the steel mounting in order to bring the working face or edge of the diamond into proper position of relation, but this may usually be done without difficulty.

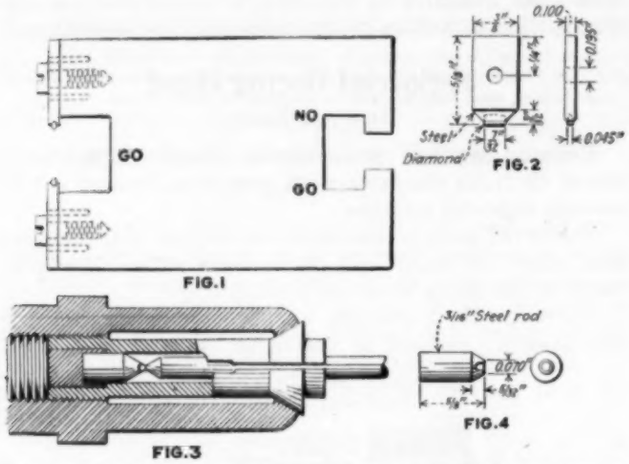


FIG. 1. A SNAP GAGE WITH JAWS OF DIAMOND. FIG. 2. DETAILS OF THE JAW. FIG. 3. A STOP IN A CHUCK. FIG. 4. ALL INSTRUCTION NECESSARY FOR THE DIAMOND SETTER

I will enumerate a few ways in which the diamond has been used to advantage:

(1) The jaws of the "go" side of a snap gage as in Fig. 1. The snap gage is used for gaging vast quantities of work—the work being gaged is dirty and sometimes carries considerable abrasive. Gages of this kind outlast the regular steel jaw gages at least two hundred times. In making up this gage a sketch, Fig. 2, was sent to the diamond firm, which provided the steel pieces and mounted and ground the diamond inserts to the desired form and size. When the steel pieces with diamond inserts were received they were fastened on the body of the gage so that the surfaces of the diamonds were parallel and the proper distance apart.

(2) A stop in the chuck of an automatic machine. In this chuck, Fig. 3, pointed pieces must be gripped accurately to length. A hardened steel stop wore out too quickly, requiring replacement every 25 hours. The diamond stop has outlasted the life of dozens of chucks and does not show any signs of wear. Fig. 4 shows all the specifications that were furnished to the diamond man for his share of the work.

(3) Jaws of a multiplying gage. We used the diamond for the jaws of a multiplying gage. Hardened steel jaws needed redressing every week, while diamond jaws have been in use for three years and show no wear.

(4) Turret stop of automatic machine. We have inserted small diamonds in stop for the screw machine where work with small pointed ends must be accurately chucked to length.

Chatter in Milling Machines

BY ELAM WHITNEY

Referring to P. V. Vernon's article under the above title on page 386 of the *American Machinist*, revealing a heretofore unpublished cause of chatter, it seems to the writer that the so-called sharp tooth was only another name for either an incorrect cutting or face angle, or an insufficient clearance angle which condition was temporarily corrected or at least improved when the cutter teeth were stoned.

Dimensions of Woodruff Keys

BY H. W. HARDY

I have used the accompanying table of Woodruff keys for many years, and as its arrangement is so convenient and self-explanatory and as I have not seen it compiled thus in any standard works of reference, I thought it would be of interest to your readers.

Where more than two keys are standard for a certain diameter of shaft the medium or middle-size key should be used. As stated on the table, the dotted lines

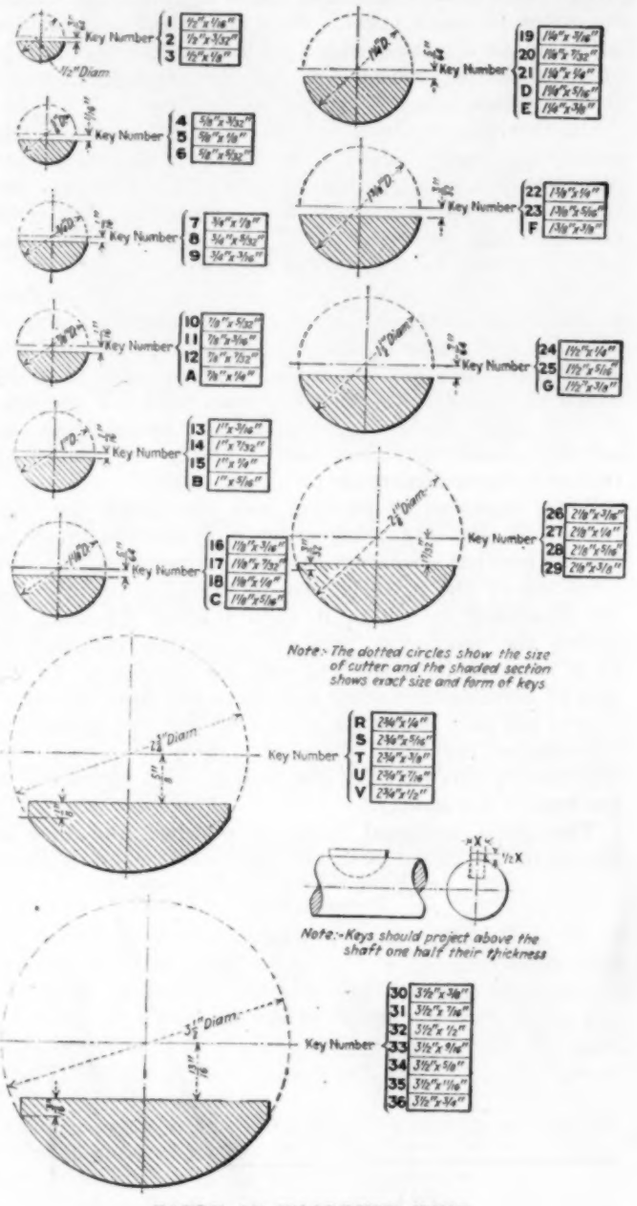


TABLE OF WOODRUFF KEYS

show the size of cutters and the shaded sections show the exact sizes and forms of keys. The keys themselves should project above the shaft one-half their thickness.

Erratum

We regret that in the article "A Device for Inspecting Gears," by Frederick Franz, in the issue of Oct. 13, the following errors appeared: The illustration showed the rack teeth with curved, instead of straight sides; pitch *diameter* in the line next to the bottom of the first column, should have read pitch *radius*.

EDITORIALS

The Twenty Per Cent That Means Prosperity

SOME one has said that there is a difference of only twenty per cent between the production figures of prosperity and depression. This ratio may be too high for some industries and too low for others, but in the machine tool field it is not far from the proportion exported in normal times. It might be otherwise stated that the value of the exported product often determines whether the yearly balance is in red or black.

Since the war the demoralization of the exchange situation has made it almost impossible to do business with Europe in any line and especially so with American machinery which has to be sold on a quality basis in any event. We must not lose sight of the fact, however, that times are going to get better on the other side of the Atlantic before long and that when they do, goodwill will be a priceless asset to the American manufacturer.

Loyal and efficient dealers are not innumerable and for this reason, if for no other, should be accorded considerate treatment. Just remember that they are facing an even tougher problem than is the American manufacturer, for he at least has what is left of the domestic market where exchange troubles do not enter in.

Here is a question that every machinery builder should put to himself for a candid answer, "If I were the foreign agent for the tools built in this plant, would I be entirely satisfied with the treatment accorded me and anxious to do everything in my power to push those tools?"

The Railroad Labor Board

THERE are many opinions as to the merits of the Railroad Labor Board and as many on the need for its continued existence. As for us, we rather sympathize with those who believe that some regulation of organized railroad labor is necessary but that the regulating, if it is to be centralized, should be in the hands of the same body that regulates rates. We have certainly seen enough of the inequality and injustice of regulating rates and labor by two independent commissions.

There has also been severe criticism of the way the board averted the threatened strike. It would have been a seven-days wonder if everybody had been satisfied. Nevertheless, we venture to say that the majority of those most affected by the strike, the people of the United States breathed a sigh of relief when the news came over the wires that the strike was called off. As remarked on this page a week or two ago, our embryo business revival could scarcely have withstood the shock of a national railroad strike.

One disquieting feature of the board's action has arisen. The docket is so full of pending cases to be decided that it will be a long time, perhaps a year, before another wage reduction can be considered, provided the disputes are taken up in order. As a matter of fact, while another ten per cent wage cut would undoubtedly save the railroads a lot of money, the revision of the working rules to an equitable basis would probably save more. Most of the pending cases are disputes over the vicious rules inherited from the late, but not lamented Railroad Administration, and much good will come if they are decided according to the ideas of common justice. Savings so made would be fairer to all concerned than those obtained from a flat reduction all along the line and would cause less discontent. The same principles apply as in the case of flat increases or decreases in freight rates.

The board is to be congratulated for its statement of October 30 where it points out that a strike in violation of a finding of the board forfeits for the strikers all rights before the board. The statement also brings out clearly the interest of the public in a transportation tie-up. Here are two points for labor leaders to consider carefully.

All things considered we feel that this Railroad Labor Board has done about as good a job as is possible under existing legislation.

Let the Army Help Commercial Aviation

LEST we forget that other nations are developing commercial aviation even if we are lagging behind, it is interesting to note that France has five international air-lines. These are Paris-London, Paris-Brussels-Amsterdam, Paris - Strasbourg - Prague - Warsaw, Toulouse-Casablanca, and Bayonne-Bilboa-Santanden. In addition there is the Bourdeaux-Toulouse-Montpelier line which is entirely within French borders. The total is about 3,500 miles.

Reports for the first half of 1921 show that over 565,000 miles were flown with very few accidents, two pilots and two passengers being killed and three pilots and one passenger injured, out of 3,388 passengers carried. Parcels and packages weighing over 161,000 pounds were carried, showing a decided improvement over the previous year.

These lines are partially subsidized by the Air Department of the French government, while we have never been strong for this kind of encouragement. The fact remains, however, that as all tariffs are indirect subsidies this would be no marked departure from our previous customs.

Instead of subsidies, however, it would seem better to provide public landing fields, and to equip the important points with supplies and repair facilities. A portion of the Army could well be assigned to this duty and thereby secure good training, while at the same time aiding commercial aviation in a substantial manner.

This is an excellent chance for co-operation between the cities or states and the Federal Government. The cities or states might well supply the landing fields to be manned by the Army for the development of aviation for all purposes. We have too long neglected our opportunities and as a result many European countries are leading the way. Isn't it time we woke up and got busy?

Shop Equipment News

Van Norman Piston and Valve Grinding Machine

A machine especially adapted to the use of garages and service stations for the repairing of automotive engines, but equally serviceable in other shops where there are small parts to be turned and ground, has been brought out by the Van Norman Machine Tool Co., Springfield, Mass. Combining many of the functions of the lathe with those of both the internal and external grinding machine, it lends itself readily to the turning, regrooving, and grinding of pistons, refinishing of valves and wristpins and for similar work upon many of the small parts that require renewal or repair.

The machine, as shown in Fig. 1, is self contained. The work spindle and the grinding wheel spindle are driven by independent motors of ¼ and ¼ hp., respectively, and to put the machine into service requires only the attachment of two plugs to lamp sockets. The bed is a single casting. The work table, carrying the headstock and the tailstock, slides upon ways and has a traverse of 14 in. It is operated by the capstan wheel at the left and has an adjustable stop to limit its movement in one direction, so that it may be returned to position with certainty after being run out for the purpose of gaging or inspecting the work. The work spindle is of steel, carbonized and hardened, and runs in taper cast-iron bearings, so that by means of thrust collars and ring nuts it may be adjusted to compensate for wear. There is a hole through the spindle, and the nose is fitted to receive standard draw-in collets up to ¾-in. capacity.

The motor is mounted directly above the spindle and drives it through spur gearing, change gears being provided for a range of spindle speeds from 63 to 170 r.p.m., with a speed of 1,700 r.p.m. of the motor. The head swivels at the base through a range of 50 deg. either side of the center, the base being graduated to facilitate setting. A taper pin locks this movement at either zero, 30 deg. or 45 deg. on either side.

The wheelslide is gibbed to the base and has a cross travel sufficient to enable an 8-in. grinding wheel to be used upon external surfaces of work 8 in. in diameter, and also to bring the wheel spindle forward of the center line when using small wheels to grind internally.

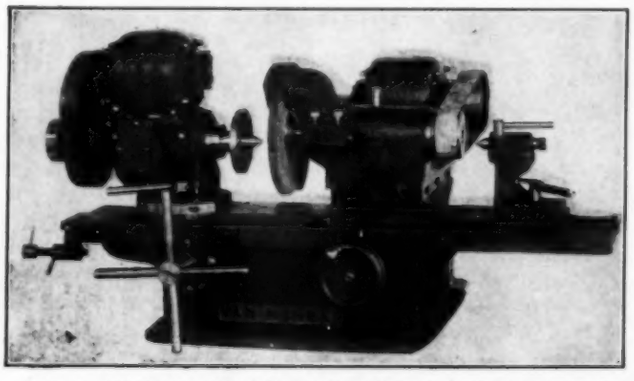


FIG. 1. VAN NORMAN PISTON AND VALVE GRINDING MACHINE

The cross movement is actuated by the handwheel to the right, and the screw is fitted with a micrometer dial. The wheel spindle runs on ball bearings at a speed of 2,800 r.p.m., being driven by a belt from a motor mounted on the same slide. The position of the motor is adjustable, for the purpose of maintaining the belt tension. The spindle carries an 8 x ½-in. abrasive wheel, and there is also a taper hole in the end to take arbors for carrying the small wheels for internal grinding.

Upon the front end of the cross-slide there is a boss for carrying a toolholder for standard ¼ and ⅜-in. toolbits. As both longitudinal and cross movement are available, with a tool in the holder the machine becomes a lathe. When so used the wheel is, of course, dismounted and the wheel spindle remains idle. The tailstock is provided with a socket for holding a diamond with which either the internal or external wheels may be trued. The machine will swing work 8 in. in diameter and take 12 in. between centers.

Besides the draw bar for the collets, there is a special

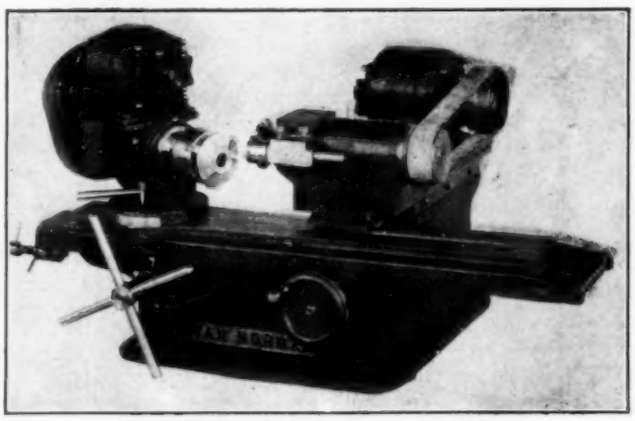


FIG. 2. SET-UP FOR ANGULAR TURNING

draw bar for holding pistons by means of a pin passed through the wristpin hole. The small driving plate is recessed to take adapter plates, which are merely disks of cast iron, with a boss on one side to fit the recess, while the other side is fitted to the piston. Pistons are mounted, dismounted or returned to place with accuracy, being centered by the bore of the skirt.

With the wheel dismounted and a tool in place in the holders, as in Fig. 2, a piston may be turned, faced, and the grooves trued up, at the same setting in which the grinding is done. The illustration shows how angular boring, turning, or facing is done on work held in the chuck, employing the swiveling feature of the head.

In Fig. 3 is shown the method of grinding poppet valves. The valve-seating reamer is ground as in Fig. 4, by using the machine as a cutter grinder with the swiveling head locked in the 30-deg. position. After the cutter is ground, the valves are held by the stems in spring collets and ground without disturbing the angular setting, insuring absolute mating of the surfaces. The seating reamer and finger rest constitute a part of the regular equipment.

The machine may be used for general machining work

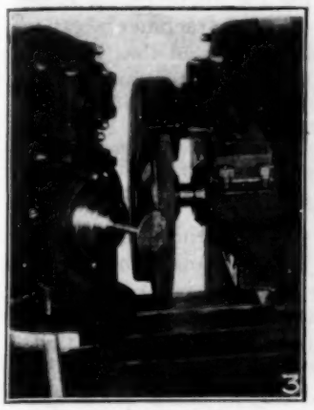


FIG. 3. GRINDING A VALVE. FIG. 4. GRINDING THE CUTTER

on jobs arising in a garage. With a turning tool in the holder, the commutator of a generator armature may be turned; and by turning the tool over on its side and running the table back and forth by means of the capstan wheel, the mica separators may be scored out between the bars. Substituting the wheel for the turning tool, the commutator may be finished by grinding, if desired.

The machine occupies a bench space of 3 x 4 ft. and weighs 330 lb. The absence of countershafts or other external means of driving renders it available for use in cramped spaces, or where there is no source of power other than the lighting circuit. Motors for any standard voltage and frequency, or for direct current, can be furnished.

Davis-Bournonville Line of Tube Welding and Fabricating Machinery

The Davis-Bournonville Co., Jersey City, N. J., has recently placed on the market an entire line of machinery for the manufacturing of welded steel tubing. The line consists of slitting, forming and welding machines for making the rough tubing from the plate, as well as other machines for performing the fabricating processes such as straightening, grinding the seams, drawing, swaging, bending and cutting off. The machines are intended for use by manufacturers of products requiring tubing in large quantities, the number, type and size of the machines used depending upon the character of the tube products turned out.

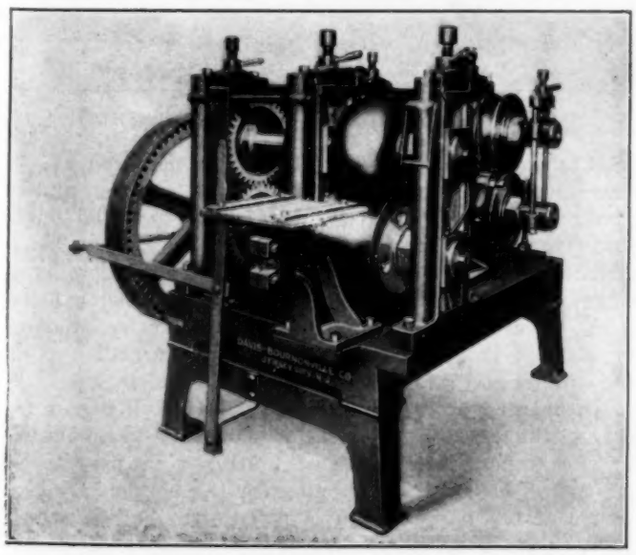


FIG. 1. DAVIS-BOURNONVILLE TUBE-FORMING MACHINE NO. 2

The first step in the process of making the tubing is to slit sheet steel into strips of the required width. For this purpose a gang slitting machine is furnished, steel up to 10-gage thickness and from 18 to 52 in. in width being handled, according to the size of the machine.

The strip stock is then run through a forming machine, in order to give it the required shape. Fig. 1 shows the No. 2 tube-forming machine, having a capacity range from 1⅛ to 3 in. in diameter and capable of handling steel up to 14-gage. The machine is also made in No. 0, 1, 1½ and 3 sizes. A hollow conical conductor between the roll stands completes the forming started by the first pair of rolls, and the second pair compresses the tube into a true circular shape. A two-roll stand is shown, although three-roll stands can be furnished for use on large tubing. The machine can operate continuously and requires but one attendant.

The tubing is then welded on a machine of the type shown in Fig. 2. This machine is made in two sizes, the No. 2 machine having a capacity from 1¼ to 4 in.

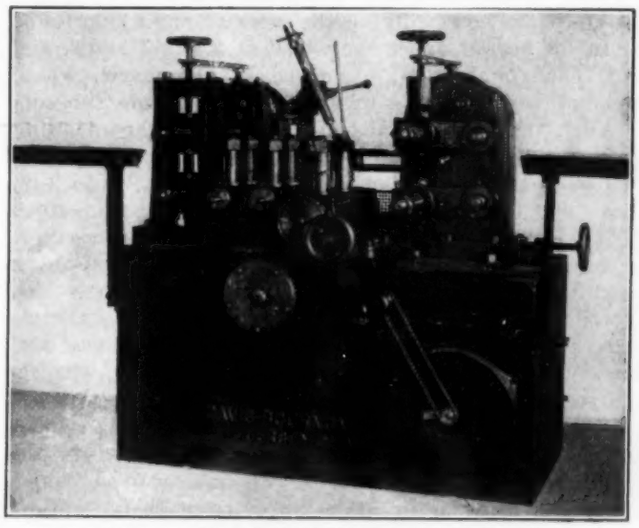


FIG. 2. TUBE-WELDING MACHINE NO. 2

in diameter on 10-gage steel, being illustrated. The rolls are not in place on the machine shown, it being easy to remove them because of the fact that the spindles holding them are over-hung. In order to vary the speed of the tubing through the machine, a d.c. adjustable-speed motor giving welding speeds from 24 to 168 in. per minute is provided. The bearings that are subjected to heat are water cooled. The bearings in the base are lubricated from a central oiling station. An oxy-acetylene torch is carried on an adjustable arm, and the welding is done continuously as the tubing passes through the machine. The welding torches are of the multi-flame type, the number and arrangement of the flame depending on the diameter and gage of the tubing being made. The larger tips are cooled by the circulation of water through chambers in them. Acetylene generators can be furnished in order to supply gas for the torches.

A machine is made for straightening the tubing after it has been welded and passed by the inspector. In Fig. 3 is shown a machine for grinding off the ridge made on the outside of the tubing by the welding. The machine consists of a 7½-hp. a.c. motor, provided with

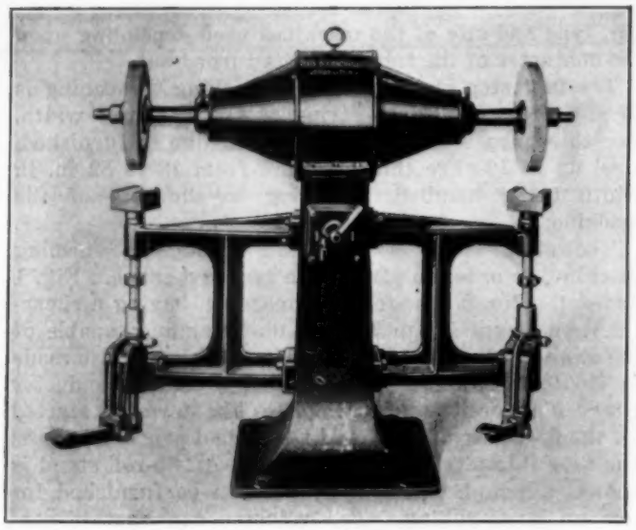


FIG. 3. MOTOR-DRIVEN TUBE-GRINDING MACHINE

a starting device and carrying two grinding wheels. The foot control is so attached to the tube guide as to vary the pressure of the tubing against the wheel, and also to permit of swinging the work to any angle. The tubing is passed under the wheel at a slight angle, and the "flash or bead" is removed by the wheel, which becomes worn concave to fit the form of the tubing.

When the tube is finished by drawing, the grinding operation is not necessary. Draw benches are furnished in two sizes, the smaller having a capacity up to 2-in. tubes and the larger up to 3-in. tubes of 14-gage steel. If it is desired that the inside of the tube be smooth, it is necessary to draw it over a mandrel. Tube-swaging machines are furnished in three sizes. By their use, rectangular, hexagonal, and other shapes may be made from the round tubing, roller dies being employed and the tubing forced over a mandrel or block of the required shape.

A cutting-off saw is provided for cutting the tubes to the proper length. The motor is mounted in the bottom of the machine on an oscillating head, which carries the saw arbor. The pressure of the operator's foot on a treadle tilts the head, so as to bring the saw in contact with the tube to be cut. The saw ordinarily used is 14 in. in diameter, its ball-bearing arbor being driven at a speed of 3,000 to 4,000 r.p.m. by means of a 5-hp. motor.

For bringing the tube to the shape desired, tube-bending machines in three sizes are made by the concern. The machines are ordinarily equipped with

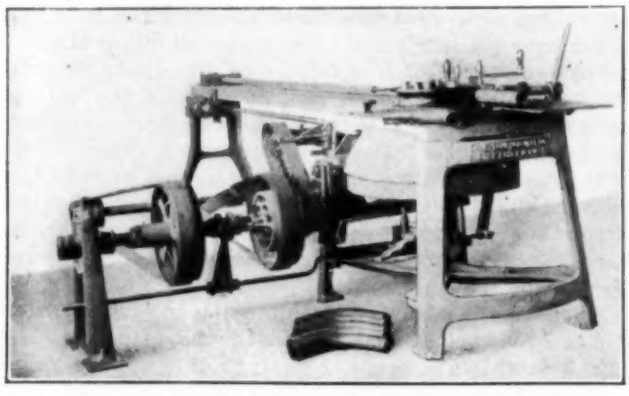


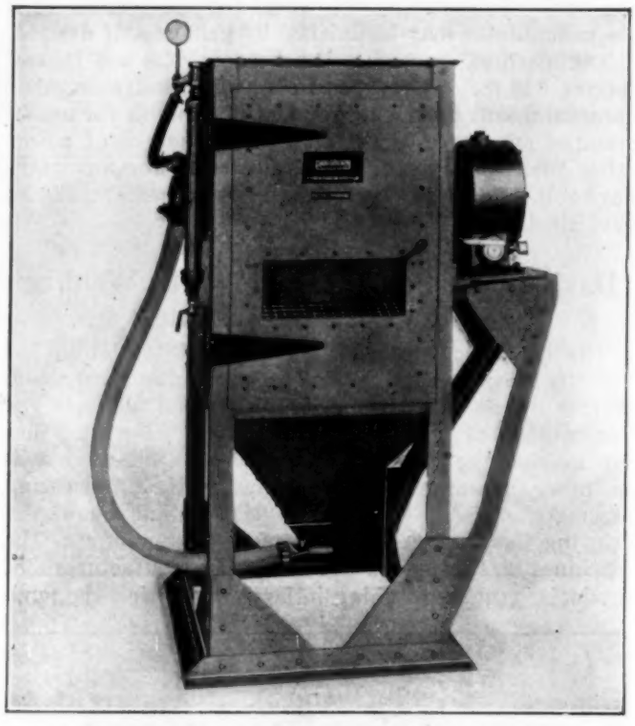
FIG. 4. TUBE-BENDING MACHINE NO. 2

double-clutch pulleys, to provide for operation in either direction. Back benches and power attachments can be furnished, as shown in Fig. 4. It is said that the construction of the bending mechanism makes possible the bending of thin-wall tubing without wrinkling or distortion.

Pangborn Sand-Blasting Machine

The illustration shows a sand-blasting machine recently placed on the market by the Pangborn Corporation, Hagerstown, Md. The machine is of the barrel type, and is especially intended for use in small industrial plants where the parts to be cleaned are not large and where only comparatively small capacity is required. It is said to be applicable to use in small brass foundries, and for cleaning small heat-treated parts or pieces to be galvanized, plated or enameled, or work that requires machining or grinding.

The device consists of a sheet-metal, dust-tight cabinet or housing, on a structural steel frame. The bottom is a hopper to receive the abrasive, and is equipped with a feed box to which is attached a hose that conveys the



PANGBORN SMALL SAND-BLASTING MACHINE

sand to the nozzle. The barrel or drum mounted within this cabinet is 24 in. in diameter by 16 in. long, and is constructed of perforated sheet metal, mounted on a shaft at one end and supported in bearings of large size. This shaft is equipped with a gear engaging a worm on the main driving shaft, the latter being fitted with tight and loose pulleys. The entire driving mechanism is contained in a cast housing, all outside the cabinet and integral with the structural frame.

An opening at the side opposite the driving gear receives the nozzle, which is mounted on a swinging bracket to permit of easy access. Dust-tight doors close the barrel housing and opening for the nozzle. The interior of the barrel drum is fitted with baffles, which turn the load as it rotates slowly, bringing all pieces and all faces under the blast action. The spent abra-

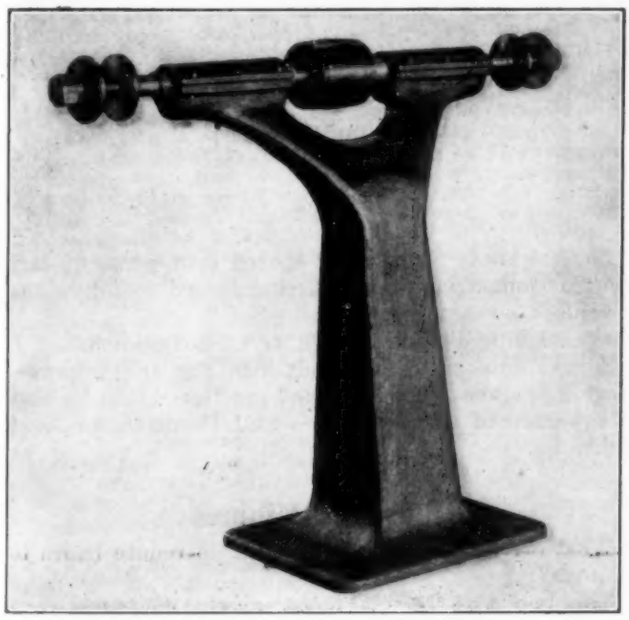
sive drops through the perforations of the drum, through a screen tote box beneath the drum, and into the hopper for re-use. The tote box receives the load when the barrel is dumped.

A door the full length of the drum is held in place by a double spring latch. An opening is provided in the top of the cabinet for attaching to an exhaust system. The machine occupies a floor space of 2 ft. 7 in. x 3 ft. 6 in. and is 5 ft. 6 in. high.

St. Louis "Western" Polishing Machine No. 10

The St. Louis Machine Tool Co., 932 Loughborough Ave., St. Louis, Mo., has recently placed on the market the No. 10 size of its "Western" polishing machine, shown in the accompanying illustration. The machine carries an arbor 48 in. long, so that there is considerable overhang on each side. The wheels are 38 in. apart and the bearings are 1¼ by 9 in. in size. Low-frictioned metal is used in the bearings, which are self oiling.

The arbor is made of 0.40 carbon steel, and the threads are of square section and coarse pitch. The

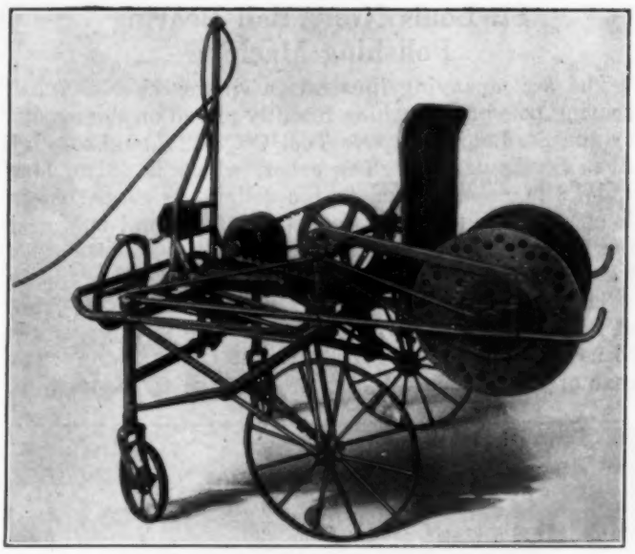


"WESTERN" POLISHING MACHINE NO. 10

height of the center of the arbor above the floor is 34 in. Taper-pointed arbors can be supplied. The machine can be furnished either with a plain pulley, as shown, for use with a countershaft, or with tight and loose pulleys. Either a plain or a pull-type countershaft can be provided, its weight being 165 lb. The countershaft tight and loose pulleys are 8 in. in diameter and 5 in. wide. The weight of the countershaft is 165 lb., and that of the polishing machine itself 260 pounds.

American Foundry Equipment Co. Sand-Cutting Machine

The American Foundry Equipment Co., 366 Madison Ave., New York, N. Y., has recently placed on the market the Type H small sand-cutting machine, shown in the accompanying illustration. The machine employs power only for the rotating of the cutting cylinder. It is propelled and guided by hand, a handle for the



AMERICAN HAND-PROPELLED SAND-CUTTING MACHINE

operator being provided at the front of the frame. The machine weighs less than 700 lb., it being stated that lightness is obtained without sacrificing strength, by the use of seamless tubing for most of the members.

The bronze-bushed front wheels are of the caster type, and 12 in. in diameter. The rear wheels are 26 in. in diameter and mounted on roller bearings. The cutting cylinder, which is 36 in. wide and 26 in. in diameter, is carried in approximate balance upon a tilting frame which has its fulcrum just forward of the center of the rear wheels. The frame can be tilted backward by means of a handwheel at the front of the machine, so as to lower the cutting cylinder. For the sake of safety, it is possible to instantly raise the cylinder by hand, independent of the handwheel.

Current is brought to the motor, which is of 2 hp. capacity, through a flexible cable from a plug located conveniently in the foundry. A V-belt and a roller chain serve to transmit the power to the cylinder itself. The machine is 7 ft. 4 in. over all in length and 55 in. wide, while its clearance above the floor is 20 in. It is especially intended for use in small foundries, where the sand is ordinarily cut and tempered by means of a hand shovel. It can be adapted to use on core and facing sand, as well as on the ordinary floor sand.

"Industrial" Indexing Table

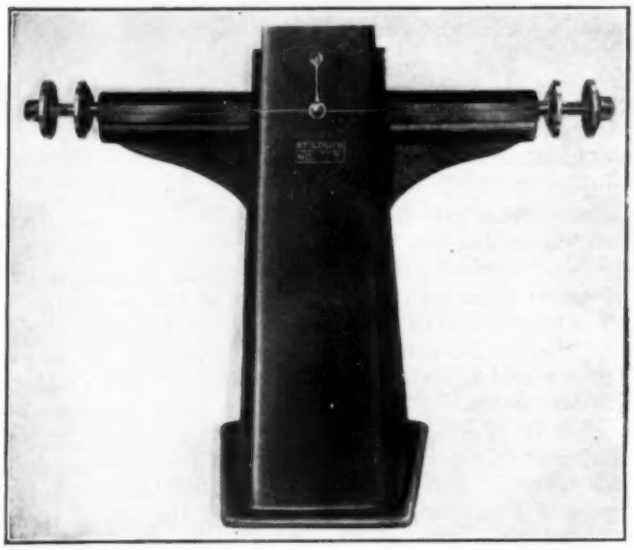
The Industrial Engineering Co., 407 E. Fort St., Detroit, Mich., has recently made some additions to its line of auxiliary indexing tables or "index bases" intended for use on machine tables, and described on page 529, Vol. 54, of the *American Machinist*. The device there described can be indexed to but two positions for each revolution. The table is now furnished to index at either three or four positions per revolution. The size and the principle of the device are the same in each case.

The circular table is indexed and clamped by but one movement of the lever, so that work can be rapidly brought to the required position for milling, drilling or reaming operations. The device is made in two sizes, the table being 10 and 16 in. in diameter. If desired, it can be furnished to index at other positions than at 90 and 120 deg., so as to suit special work.

St. Louis No. 7 Ball Bearing Polishing Machine

The accompanying illustration shows the No. 7 ball bearing polishing machine recently placed on the market by the St. Louis Machine Tool Co., 932 Loughborough Ave., St. Louis, Mo. The arbor, which is 56 in. long and 1¼ in. in diameter in the collars, is supported in four ball bearings, two near the wheels and two near the pulley. The parts can be easily dis-assembled when it is desired to inspect the bearings.

The base of the machine is a heavy casting, the front of it being vertical, while the rear face is at an angle, so as to increase the floor space of the machine. The rear of the base is 4 in. wider than the front, so as to



ST. LOUIS NO. 7 BALL BEARING POLISHING MACHINE

give a greater support and larger footing to the machine without decreasing the standing room for the operator. Since the pull of the belt is usually toward the rear, the construction enables the machine to stand more solidly. The total size of the base is 23 x 24 in., and the height to the center of the arbor is 38 inches.

The machine is shown equipped with a belt guard for use when driving from an overhead pulley. The handle at the front is for shifting the belt when both tight and loose pulleys are mounted on the arbor. When an overhead countershaft is used, the shifting mechanism is not employed. The machine can be driven from beneath the floor, the belt being enclosed in the base and a guard being placed over the arbor pulley. When tight and loose pulleys are used on the arbor of the machine, the belt-shifting device is operated by a lever placed at the side of the base and under the head.

A self-oiling countershaft, having a drop of 12 in. and 10 x 6-in. tight and loose pulley, can be furnished. The weight of the countershaft is 250 lb. and that of the polishing machine 530 pounds.

Parker Nameplate Drive-Screw

The illustration shows a device recently brought out by the Parker Supply Co., Inc., New York, N. Y., primarily for permanently attaching nameplates and trade marks to machines. The drive screw has a thread of very quick pitch and a slotless head.

To insert it, holes of a size a trifle larger than the cylindrical point or pilot are drilled, and the screw is driven in with a hammer. Since the entire screw is hardened and heat-treated, the steep-pitch threads cut their way into gray iron or any soft metal. Since the head is not slotted, the screw cannot be removed except by cutting off, thus making it difficult to substitute another nameplate for the one originally fastened to the machine. It is adapted to other uses where a quickly made, permanent fastening is required.

PARKER DRIVE-SCREW

Industrial Spur Gears

The recommended practice of the American Gear Manufacturers' Association as adopted April 28, 1921, is as follows:

The width of face for industrial spur gearing shall follow the following recommended practice: 10 divided by the diametral pitch.

It is recommended that the following table be used for convenience, as closely adhering to the above formula:

Diametral Pitch	Inches Face	Diametral Pitch	Inches Face
1	10	5	2
1¼	8	6	1⅔
1½	7	7	1⅓
1¾	6	8	1¼
2	5	10	1
2¼	4½	12	⅚
2½	4	14	⅝
2¾	3⅔	16	⅝
3	3⅓	18	½
3½	3	20	½
4	2½		

The thickness for rim for spoked spur gears of cast iron for industrial work is recommended to follow the formula:

4 divided by diametral pitch, or 1.3 x cir. pitch.

Suggestions or recommendations for the improvement of the above recommended practice should be sent to the office of the secretary—4401 Germantown Ave., Phila, Pa.

Hours To Minutes

What are you doing in your firm, to reduce hours to minutes?

This is one of the vital questions that measures your efficiency. Nearly all profits and high wages and low costs depend upon reducing *hours to minutes.*

For instance, a typewriter with a quick typist writing sixty words a minute, reduces an hour to twenty minutes.

A comptometer reduces an hour to fifteen minutes, as it does the work of four clerks.

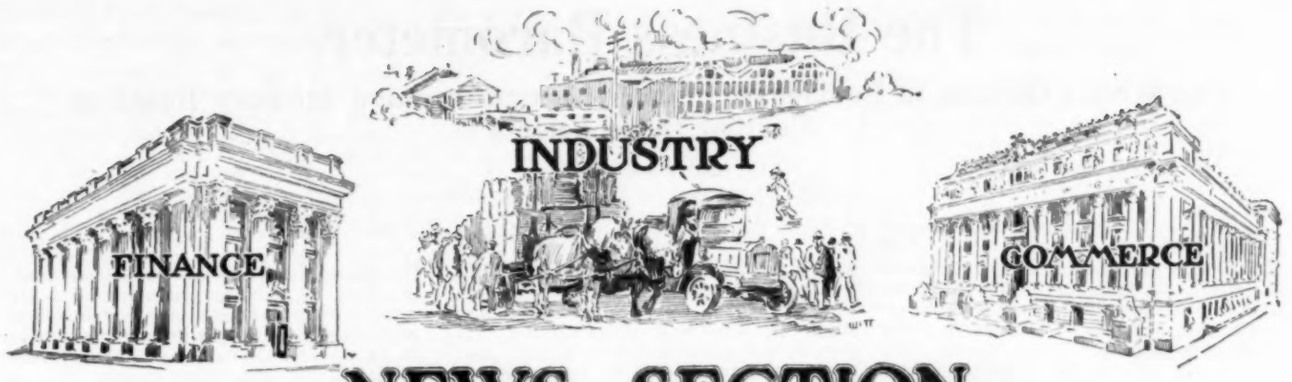
A steam shovel reduces an hour to three minutes, as it does the work of twenty laborers.

A printing-press reduces an hour to perhaps one-fortieth of a second, as it would take forty men one hour to write one copy of a ten-page newspaper which a press prints in a second.

In these days of high cost it is the *time element* that makes you or breaks you.

The Pharaohs of Egypt were never bothered by the time element. They could take a whole lifetime just to build one pyramid; but you and I are not so lucky.

Our one main hope of success is in reducing hours to minutes—in getting more work done in less time.—*Efficiency Magazine.*



NEWS SECTION

Industrial Relations Association Convenes at New York

Spreading its meetings and conferences over a period of four days, the Industrial Relations Association of America held its annual convention at the Waldorf-Astoria Hotel, in New York City, on Nov. 1, 2, 3 and 4. The convention was one of the best attended which the association has ever held, and the subjects discussed had a most important bearing on the problems of present day industrial enterprise.

Most of the speakers were directors of personnel work, or employment managers in large corporations. They brought to the conference a diversity of ideas, which they exchanged freely on the speaking platform, thus giving an unusual opportunity for the audience to absorb an invaluable amount of information and data on a subject which is receiving a lot of attention during this time when employment is one of the greatest of our industrial problems. Many suggestions were offered as a panacea for present employment ills, and no doubt much good will come from the open and instructive lessons that were presented.

On Friday evening a dinner meeting was held at the Hotel Astor in conjunction with the Academy of Political Science. The Hon. Herbert Hoover, Secretary of Commerce, presided and also delivered the introductory address, his subject being, "The Value of Good Will and Co-operation in Industry."

The convention ended on Saturday with another joint session of the two organizations at which subjects of mutual interest were discussed. In our next week's issue we hope to publish a more comprehensive report of the convention, giving if possible, abstracts from the more important addresses.

Taylor Society Meeting

A tentative program has been announced for the annual meeting of the Taylor Society, to be held in the Engineering Societies Building, Thirty-ninth Street, New York City, on Dec. 1, 2 and 3. One session will be devoted to an examination and discussion of the evaluation sheet devised by Secretary Hoover's "Committee on Elimination of Waste in Industry." Other sessions will be devoted to sales engineering, production managers and plant executives, sales cost accounting, scientific management and labor management.

Business meetings, luncheons and dinners will be held at stated periods during the convention.

Motor Service Costly To Postal Dept.

The joint commission on postal service has submitted its report to Congress. That portion of the report referring to the motor vehicle service reads as follows:

"The survey has brought to attention that the cost of motor vehicle service in all the cities investigated is enormous and that it constitutes one of the largest items of expense. It has developed that in all the different cities there has been lack of uniformity in the fleet, necessitating the maintenance of most varied stocks of miscellaneous stocks for repairs and replacements. There has been the added embarrassment that the chauffeurs have unnecessarily been called upon to operate different makes of trucks, so that they have not been able to develop that familiarity with any one type which would enable them to operate it with a maximum efficiency and at the minimum cost. The Postmaster General, to whom these facts have been submitted, has recently placed at the head of the motor vehicle service a man who has been selected as an expert. Among other reforms it is planned to reduce the type of machines from 30 to 8, and various necessary improvements are under way.

"The cost of operation per hour and per mile, and the cost of repairs in certain cases, has been so great as to prompt inquiry as to whether or not a contract system would not be more advantageous to the Government than ownership, but at this time no recommendation on this point is made."

Better Packing Needed for Far Eastern Climate

Complaints are coming to the Department of Commerce from many quarters that automobiles and machinery of different kinds are reaching their destination in the Far East much damaged by rust and moisture, owing to inadequate protection in packing against the damage which is likely to be suffered from a hot and moist climate. Certain American manufacturers are making waterproof papers to meet this need, some of which are wide enough to cover the full width of the standard sizes of automobile cases, so that the cases are completely lined without seams except at the corners. This matter of protection against moisture is of very great importance, as existing methods make purchasers unwilling in many instances to buy American machinery.

Publishers Discuss Ways to Speed Revival of Business

Representatives of 122 publishers of technical, trade and business papers, comprising the Associated Business Papers, Inc., met in Chicago on Oct. 24, 25 and 26 to discuss the publishers part in speeding the revival of business.

The key-note address, delivered by James H. McGraw, president of the McGraw-Hill Co., Inc., was received with great enthusiasm.

Harry Newman Tolles, vice-president of the Sheldon School, portrayed the causes of lazy habits of salesmen, which grew up during the prolonged sellers' market.

Earl B. Hill, chairman of the surplus property committee, gave a report of the economic service rendered by the business papers in disposing of millions of dollars worth of surplus government property through advertising. A large percentage of this advertising was placed in business papers and the results have proved so satisfactory that several foreign governments are considering the adoption of similar methods.

David Rosenblum, vice-president of the Business Training Corporation, New York, explained the course in industrial publishing which has been initiated by the New York Business Publishers.

Among important business matters receiving attention of the convention was the auditing of publications of free circulation by the Audit Bureau of Circulations. A resolution was passed requesting the "ABC" to discontinue the auditing of such publications, since free circulation is contrary to the basic principles of legitimate publishing, and circulation statements have the effect of misleading advertisers who have come to associate the "ABC" with ethical standards of publishing. The new officers elected for the ensuing year are as follows: President, James H. McGraw, McGraw-Hill Co., Inc.; vice-president, A. O. Backert, Penton Publishing Co.; treasurer, Fritz Frank, Iron Age Publishing Co.

German Oil-Engined Plane

To reduce the cost of "airway" working, by replacing the petrol motor by an engine using crude oil and working on the semi-Deisel principle, is now the aim of Professor Junkers, whose German all-metal monoplanes are well known. Professor Junkers has been experimenting for some time with adaptations of the Deisel system, and it is now reported that an experimental six-cylinder engine has been used in an airplane and has worked promisingly.

The Business Barometer

This Week's Outlook in Commerce, Finance, Agriculture and Industry Based on Current Developments

BY THEODORE H. PRICE
Editor, *Commerce and Finance*, New York

(*Copyright, Theodore H. Price, Publishing Corporation, 16 Exchange Place, New York*)

In so far as America is concerned nearly all the facts of the commercial and financial situation are encouraging. Credit is abundant. The reserve ratio is again higher at 71 per cent. We have a gold reserve so large that it is plethoric. It gained fourteen millions last week. Interest rates are coming down, as witness the reduction of the rediscount rate by ten Federal Reserve Banks last week.

Commodity prices are so low that distributors run but little risk in stocking up. Making allowance for the decline in prices bank clearings indicate that the turnover of goods is as large as it was a year ago and nearly every one whose opinion carries weight is talking optimistically.

Feeling is, however, as important as facts and it must be admitted that the business complex lacks resiliency. Enthusiasm is wanting and doubt of the future seems to have laid its chill hand on the entire community. The reasons for this discouraging apathy are mainly political. I mean political in a philosophic and not a partisan sense.

There is a consciousness that the problems of government are becoming increasingly difficult. The future of civilization depends upon the ability of statesmen to maintain peace, preserve order and equitably distribute the cost of government while adequately protecting the rights of the governed and their property. There seems to be a fear that with the burdens and the enmities that war has created this will prove to be impossible and the present hesitancy is a consequence of this fear.

There is an eager hope that at the Disarmament Congress to convene this week a way will be found to resolve international antagonisms and make it impossible for the nations to fight by taking away their weapons but there is also a realization that the effort may fail and that the world may remain an armed camp for the maintenance of which society would have to bankrupt itself. It is this latter contingency that causes men to pause and makes it the duty of every one to work and pray that a meeting of minds may be brought about at Washington.

Meantime the business outlook reminds one of an unfrequented street paved with cobblestones between which the grass persists in growing despite the discouragement of the stones and the passage of an occasional vehicle.

One of these stones is the tax bill which the Senate is trying to fashion. Most business men will join with Senator John Sharp Williams in his appeal to both sides of the chamber "to do more voting and less talking and let the American consumers and the American taxpayers find out where they are."

Another stone is the predicament in which the Western farmers find themselves as a result of the decline in wheat and corn and the high freight rates. One of them who lives in Indiana writes me that many of his neighbors will be unable to pay the taxes now due because of the heavy losses they have made on the year's operations. He argues that since the Government guarantees the miner $18.60 an ounce for his gold and has under the Pittman act recently undertaken to pay $1 an ounce for silver of American production the farmer is entitled to similar quarantees for the product of his toil, and adds that unless something is done to reduce the speculative hazards of agriculture it will be abandoned.

A third stone is the labor unrest which though it was quieted in the case of the railroad workers is again manifest in the New York milk strike and the strike of the bituminous coal miners which may involve nearly 200,000 men.

It is reassuring and really surprising that in the face of so many untoward developments some markets have advanced and that no commodities except grain have declined seriously.

As to wheat and corn it seems a clear case of a surplus and no demand for export. Cotton has been steady but the demand for cotton goods is becoming less active. Coffee is up another half cent on buying attributed to the Brazilian government but more probably due to a public realization of the smallness of the supply held in this country. Raw sugar is firmer for the same reason. Reports from the steel industry are conflicting but agree as to the increased output of both iron and steel.

More copper is being sold but prices are not much changed. A further advance of 50 cents a barrel in Pennsylvania crude petroleum is announced. If the trade reports are to be believed lumber is higher and more building is being undertaken as winter draws near, which is at least unusual, while the year's totals to date show the amazing increase of nearly 200 per cent over the 1914 figures. With the steady revival of industry this accounts for the decrease of a million in the number of unemployed reported during the month.

The European outlook like our own is beclouded by political and social unrest. The Irish question has again become acute. The dexterity of Lloyd George is being sorely tried in dealing with it but the indications are that he will succeed. The Bank of England has reduced its rediscount rate to 5 per cent. Marks are again lower at 47 cents a hundred in New York and the shelves and shops of Germany are being swept clear by those who are trying to exchange marks for goods. It is officially announced that the Reparation Commission has allowed two weeks of grace on the payment due Nov. 15. Just how a financial debacle can be avoided in Germany is not clear.

But on the New York Stock Exchange, where all these perplexities and troubles should be first reflected, placidity has reigned. Many securities are higher and but few are lower. Railway shares are steady but no higher as the remarkable increase in net earnings is offset by the fear that public sentiment which is becoming very insistent will shortly compel a general reduction in rates, and there is further evidence that railway managers realize this in the cuts announced by the Southern Pacific and Union Pacific. The vigorous propaganda of the railway companies whose purpose seems to be the exploitation of their own property says nothing about the increase in traffic that lower rates would induce.

The bond market shows increased strength and the ease with which new offerings are absorbed is remarkable. They run into the millions and anything that can be called a bond seems to be salable. This is of course due to the decline in interest rates but it is to be observed that the default of the Chinese government in meeting the loan of $5,500,000 due Nov. 1 has somewhat dampened the American demand for foreign securities. This loan was payable in dollars and was placed here in 1916, being one of the first foreign loans sold in this country after the war had commenced. One result of the default may be to reconcentrate the investment of American capital in America. If so it will probably be impossible much longer to avert the inflation which most economists agree will sooner or later be a consequence of our continued importation of gold.

As interest rates fall and gold becomes cheaper it will be exchanged first for bonds, as at present; then for stocks and afterwards for merchandise.

This has always been the case in the past and there is no reason to expect any change in the sequence or the event.

International Chamber To Meet at Rome in 1922

Announcement was made last week by the American Section of the International Chamber of Commerce, that the second annual meeting of the International Chamber will be held in Rome, Italy, during the week of Sept. 18, 1922. At the first annual meeting held last June, in London, more than 200 American business men attended.

The date for the next meeting was decided upon at a meeting of the Council of the International Chamber just held in Paris. The United States was represented at this meeting by Owen D. Young, vice-president of the General Electric Co.; E. A. Filene, president, William Filene's Sons Co., Boston; and Elliot H. Goodwin, vice-president of the Chamber of Commerce of the United States.

Eighteen countries now hold membership in the International Chamber, and a number of other countries have applied for admission. The countries already admitted are: Argentina, Australia, Austria, Belgium, Czecho-Slovakia, Denmark, France, Great Britain, Italy, Japan, Luxemburg, Netherlands, Poland, Spain, Sweden, Switzerland, and the United States.

Industrial Cost Association Holds Second Conference in Pittsburgh

With headquarters at the William Penn Hotel in Pittsburgh, Pa., the Industrial Cost Association held its second National Industrial Cost Conference on Nov. 2, 3 and 4. The meeting was well attended and the members departed with the comfortable feeling of having accomplished a creditable amount of useful work.

After registration and the other formalities had been gone through on Wednesday morning, the president, Horace S. Beck, controller S. K. F. Industries, Inc., New York, called the first session to order and made a short address. He commented on the work done by the association during its first year of existence and commended the officers and members on what had been accomplished. He also stated that it was planned for the coming year to have presented at each local section meeting a paper prepared under the direction of the executive committee of the association, in order to assist in the work of the sections.

The afternoon session was opened by an address of welcome from Mayor Babcock, of Pittsburgh, who presented the members with the freedom of the city and offered his own assistance and that of the various city departments to those members who were unfortunate enough to get into difficulties. The conference then listened to a paper read by S. B. Taylor, general manager, S. K. F. Industries, Inc., N. Y., on "What the Sales Manager Should Have From the Accounting Department." Mr. Taylor enumerated various details and figures that must be supplied by the accounting department. He laid particular stress on the need for cordial co-operation between the members of the accounting department and the members of the sales department. The plea for co-operation was strongly endorsed in the discussion which followed his paper.

E. C. Grimley, Victor Talking Machine Co., Camden, N. J., then discussed the matter of taking inventories, contrasting the time required and the benefits accomplished from the old-fashioned annual or semi-annual inventory which necessitated shutting down the plant, and the more modern perpetual inventory as practiced in most progressive plants. The discussion on this paper was read by Christopher Haigh, General Electric Co., West Lynn, Mass., and brought out many different points of view on inventory matters.

In the evening papers were read by F. S. Willett, controller, Dodge Manufacturing Co., Mishawaka, Ind., on "Responsibility of the Controller or Accountant in Times of Business Depression," and by T. W. Dinlocker and A. W. Wainwright, both of S. K. F., on "Idleness and Its Relation to Industry in Retrospect." Mr. Willett had a blueprint illustrating the operation of a business in a way to bring home to the lowest employee in the plant the problems facing management. It was examined with much interest by those present. He told of a successful plan for executive meetings as practiced in the Dodge plant and brought down the house with a parody on the recent "popular" bank statement of the Corn Exchange Bank in New York. Messrs. Dinlocker and Wainwright brought up to date the topic upon which they had read a paper at the previous conference in May, and started a discussion which was not completed at 10:30 p.m. when the conference adjourned to the Press Club for an entertainment provided by A. W. Bendig, McIntosh-Hemphil Co., Pittsburgh.

The Thursday morning session was opened by an interesting paper by Addison Boren, Yale & Towne Manufacturing Co., Stamford, Conn., on "Terminology." At the conclusion of the discussion, H. S. Britenstein, chief accountant, department of the controller, City of Pittsburgh, told in some detail of the preparation of the municipal budget and suggested ways in which the methods used by the municipality might be applied to the industrial plant and office.

After luncheon at the Heinz plant the dedegates listened to addresses by J. B. Ayres, sanitation and safety engineer, and Major Wm. Hogg, assistant to the vice-president, National Tube Co., Pittsburgh. These gentlemen described some of the safety and sanitation work of the United States Steel Corporation and outlined the actual savings in dollars and cents possible to attain.

An informal banquet was held in the evening with President Peck as toastmaster and with Sanford Robinson, New York, and Clifford B. Connelley, commissioner of labor and industry of the state of Pennsylvania, as the speakers. A number of vaudeville acts were put on to entertain the diners between the courses and served to make the dinner a memorable affair. The speeches were sent out to some 40,000 wireless receiving stations all over the world by means of the Westinghouse amplifying and transmitting device which was installed beneath the speaker's table. Commissioner Connelley warned against the dabbling in industrial relations by those people unacquainted with the problems involved. He said that his experience had shown that the possibilities for harm in such matters were much greater than for any good being accomplished. He criticised the daily press for its unwillingness or inability to supply the kind of reading matter that would educate and enlighten the masses of the people.

Mr. Robinson, who is an expert on federal taxation, started his address by outlining the history of federal taxation by the Government of the United States since its foundation, and followed that up by a short history of income tax legislation throughout the world. He called attention to the fact that until a few years before the war the tariff had been the principal means of raising revenue in this country. He then took up the various income tax laws made possible by the adoption of the 16th amendment to the Constitution and gave credit to the treasury officials for the sane and generous manner in which these harsh laws had been interpreted. Mr. Robinson stated that he anticipated a long period of general decline in prices with probable fluctuations of three or four years' duration. He said that a sales tax under such a long-time trend would in his opinion be unworkable and gave several of the stock arguments against the sales tax.

At the meeting of Friday morning, J. M. Howell, General Electric Co., Schenectady, N. Y., read a paper on "How Can a Cost System, Although Efficient, Demoralize an Organization?" In his paper he criticised the ready-made cost system as applied by certain consulting accountants and told of the harm it could do when local conditions were not taken into consideration.

Export Manufacturers Get Lesson on Postal Laws

About one hundred members of the American Manufacturers Export Association gathered at a luncheon in the Hotel Pennsylvania on Nov. 2, to listen to an address on postal regulations by O. K. Davis, secretary of the National Foreign Trade Council and a delegate to the Pan-American Postal Congress, recently held in Buenos Ayres, Argentina. The address was more in the nature of a censure of American business men and their ignorance—or laxity—in the matter of postal regulations existing between the United States and the various South American countries. Mr. Davis is well qualified to speak on this subject and his remarks, though interspersed with humorous references, were given serious consideration.

Mr. Davis told of the careless manner in which our business houses ship or mail merchandise to foreign countries by parcel post. He related some particularly flagrant instances of total ignorance of postal regulations and showed the difficulties experienced by our trade representatives in these countries to straighten out some of the tangles.

In telling of the origin of the Postal Congress, he said:

"There was no general international arrangement for the handling of international mails. Each country made its own arrangement with the other country. The Postmaster General of the United States undertook to develop some uniformity and his action led to the formation of the Universal Postal Congress.

"Every postal convention includes a paragraph right at the beginning to the effect that the provisions of the convention shall apply to letters, post cards, printed matter of all kinds, commercial papers and samples.

"Parcel post, however, is a very different business. Parcel post is a distinctly commercial affair. It is designed for the benefit and is occupied with the benefit of interchange of goods and commercial matters.

"In 1911 the ten countries of South America held a convention and established the South American Postal Union. That was held in Montevideo. That union was due to hold another meeting this year and they decided very naturally to expand it to a Pan-American Union. So they invited all the countries of Pan-America including the United States.

"There is an enormous complaint arising about the parcel post service between the United States and South American countries. A very large part of it is due to the carelessness, ignorance and indifference of our own shippers in the use of the mails. I venture to say that outside of the Postal Service in the United States there isn't one person in a thousand that knows anything about the United States Postal Guide.

Here Mr. Davis related some humorous incidents, showing the red tape and seemingly ridiculous regulations which now exist. For instance, it cost a trade commissioner in one South American city, $17.17 and a week's work to retrieve a parcel post package which contained twelve tubes of tooth paste, valued at $2.50. Other like incidents were mentioned and the apparent indifference and carelessness of American business men to postal regulations was strongly emphasized.

Effect of Railroad Strike on Mine Workers

Official Washington literally heaved a sigh of relief last Friday morning when the railroad strike order was countermanded. It was a case of the night being blackest just before the dawn, as it is known to have been the opinion within the administration on Thursday that the odds in favor of the strike had increased. While the administration had gone further in its preparation to meet this threatened strike than ever before, it was admitted generally that Federal officials are so surrounded by limitations as to be in a poor position to handle any such emergency.

In spite of everything that could have been done it is admitted on all sides that the strike would have entailed losses and would have interfered with all activities to such an extent as to bring it within the category of a national disaster. The fact that the strike has been avoided without the surrender of any principle means that the country and its business have been saved a very serious blow. There is a feeling in railroad executive circles that there never will be a better time for a "show-down." Some railroad officials are not entirely satisfied that the settlement is the blessing most people regard it. This is predicated on the assumption that the strike simply has been delayed and that no lasting impression has been made upon the labor unions. There are many, however, who believe that organized labor as a whole has been taught a lesson. Public opinion never before weighed as heavily in a labor dispute. The action of the administration in taking such prompt and effective steps to counteract the consequences of a strike came as a great surprise to many labor leaders. In fact it establishes a new policy of Federal procedure—one that has proven popular and which is likely to be followed in the future. The steps that were taken to accumulate stocks of necessities at strategic points probably will not be abandoned. Through co-operation with state and municipal authorities, none will be surprised if a plan is worked out looking to the emergency assembly of necessities at central points, so as to insure the maximum of protection to the public when a situation of this kind arises in the future.

Opinions differ as to the effect which the calling off of the railroad strike will have on the mine workers. Some believe that they will be impressed by the sentiment manifested against a railroad strike and by the attitude of national and state officials. Others are very firmly of the belief that a coal strike cannot be avoided. It is admitted by all, however, that much will depend on the conclusions that will be formed as to who is the winner of the railroad controversy. If the developments of the next few weeks are such as to make it appear as anything less than a defeat for labor, the affect on the coal strike will be correspondingly less.

Advices to the Department of Commerce indicate that during the week ended Oct. 29 as much coal was moved as the railroads could handle. Some are of the opinion that there will be a decided slump in the movement of coal because the strike is not to be called. Others think that the strike had the effect of reminding consumers that they had better lay in their supplies and wait no longer on possible reductions in freight rates and in prices. Such analysis as it has been possible to make of this coal movement indicates that large consumers were not heavy buyers. To start with the public utilities and certain other large consumers already had laid in considerable reserves of fuel. Even those consumers who had small reserves made little effort to get coal on the assumption that a strike that would prevent their getting coal also would prevent receipts of raw material and the shipment of output. Since they faced conditions which would necessitate a shut-down for other reasons, they did not worry much about the coal supply.

While the returns are not complete from the survey of coal stocks made by the Department of Commerce, enough figures were collected to indicate that stocks taken as a whole are not far from normal. Domestic stocks at this time of year always are at the low point, but even in their case there are indications that the experience of the war has had the effect of influencing some to buy coal early. Retail stocks seem to be normal with reserves sufficient for domestic consumers' normal needs for periods varying from three to six weeks. Some crumb of comfort was occasioned by the fact that considerable stocks of anthracite were available at points near tidewater and by the fact that considerable stocks of by-product coke had been built up in cities where it could be utilized to the best effect.

A thorough survey of coal stocks is to be made this month by the U. S. Geological Survey. It also is the intention to make another survey sixty days later. This survey was decided upon before the strike situation developed. In view of the possibilities of a coal strike in the spring, it is regarded as being unusually important to secure exact data as to stocks as of Nov. 1, and as of Jan. 1.

Germany Working Overtime

James B. Spencer, treasurer and general manager of the United States Hoffman Co., of Syracuse, N. Y., maker of clothes pressing machinery, returned this week from a trip to Europe. He visited England, Ireland, France, Belgium and Germany. He spent three months abroad visiting the foreign branches of the Company.

Business depression has been general in England on account of the coal strike, he says. Unemployment is general.

The rate of exchange is one factor which is holding back England's business revival, Mr. Spencer said. This is one reason, and the main one, he thinks, why English merchants are not dealing with America.

In Germany, Mr. Spencer says there is less unemployment than in any other European country. The Germans are working 12 and 14 hours a day, and while the low value of the mark is a deterrent in some ways, it is an aid to business and manufacturing revival, he says. It allows the manufacturer to get his products into foreign markets at a very low cost, and the money changed into German marks gives him a larger return than he enjoyed during the most prosperous times.

Theater Owners Aid Campaign of Education

The Motion Picture Theater Owners of America, an organization comprising several thousand members distributed all over the United States, has thrown its resources into the campaign for industrial education which is being sponsored by the Bureau of Economics at Washington. On Saturday, Oct. 29, at the Criterion Theater, New York, a conference on "Industrial America" was held; several hundred prominent educators, editors and business men attended.

The theater owners have offered the use of their properties to the Bureau of Economics, on Saturday mornings and at any other time when a regular performance is not scheduled. At these times, the bureau will supply moving pictures of branches of commerce and industry, showing how various commodities are made, prepared for market, transported and all other phases of modern trade. This is a means toward aiding the school boy or girl in choosing a vocation. Other films on subjects of interest to tradesmen, manufacturers and business men in general will also be shown.

Secretary of Labor Davis, who was unable to attend the conference, sent a message congratulating the association for its good work and promising the co-operation of his department in furthering the plans.

Speakers who addressed the conference were: Nathan D. Williams, National Association of Manufacturers; Dr. Henry E. Jackson, director, National Community Bureau; Dr. Newell Dwight Hillis, Plymouth Church on "Better America"; Francis Holley, director, Bureau of Commercial Economics. Sydney S. Cohen, president of the Motion Picture Theater Owners of America, and who is given much credit for this campaign, spoke in behalf of the owners.

First Auto Show In China

In reports received from Shanghai showing the progress of the First International Chinese Automobile Show to be held the week of Nov. 26 to Dec. 3, Consul General E. S. Cunningham states that cable requests from German and Japanese manufactures have been received, and officials of the show have given notice that exhibitors of any nationality will be allowed to take part in the exhibition.

French Airplane Construction

A London financial journal states that the French Military Air Service will next year have over 40,000 airplanes, if the army budget passes. The French Flying Corps would then be composed of 286 regiments, each of 12 squadrons. French airplane constructors are at present in a very strong position, mainly because the French government did not cancel all its war contracts, but allowed constructors to execute the greater number of them. It was thought that this would be the best way of subsidizing the French air industry.

In addition, the French constructors had in hand substantial orders from Japan and South America. It is to this policy and to the most intelligent co-operation of the French military technical services with civilian aviation that France owes her present lead in the air.

Swiss Locomotive Industry

On account of the electrification of the Swiss Federal Railways as well as most of the private lines, the building of steam locomotives has been almost entirely abandoned in this country. The Swiss Locomotive works, of Winterthur, which formerly exported a great number of steam engines to many European and transoceanic countries, is now turning out electric engines on a large scale. This company, which is the leading and largest of its kind in the country, has just published its last annual report, from which the following is gleaned.

EXTENSIVE EXPORTS

The company was well occupied with orders during the entire year. Four steam locomotives were built for the account of the Phosphate Mines of Gafsa, in Algeria, quite a number of cog-wheel locomotives were shipped to Spain and Brazil, while considerable orders calling for locomotive boilers were booked from France, British India (South Indian Railway Company), and the Argentine Republic (Buenos Aires Western Railway). Considering the fact that Switzerland has to import every pound of coal and every pound of iron for her industries it is certainly remarkable that in spite of these drawbacks and in spite of cheap competition the Swiss works are able to export to such an extent. The Swiss Federal Railways placed an order for thirty-two heavy electric locomotives, which are among the largest ever built in any country. The largest type of electric locomotives, however, is being built for the Swiss Rhetian Railways. The above locomotive works furnish for these engines, which are the largest in the world, the mechanical parts, while the rest is built by the well known Brown Boveri Electric Co. in connection with the Oerlikon Electric Works, of Oerlikon, near Zurich.

For the Paris-Lyon-Mediterranean Railway a good deal of repair work was done on steam engines, and oversea orders for a number of Diesel motors of a capacity of 1,000 hp. were also booked. As an entirely new line of manufacture the company has also started the manufacture of motors for airplanes, for which a number of orders was placed with the company by the Swiss Army Department. Considerable orders in this line are expected as soon as the final models have been decided upon. The works of the company are also busily engaged in the manufacture of especially constructed railway compressors for the generation of compressed air for the brake apparatus of electric locomotives. These will be made in great numbers.

Superpower Report of Geological Survey

Secretary of the Interior Fall has transmitted to the President the completed report of what has been popularly called the "Superpower Survey," an engineering study conducted by the United States Geological Survey. The appropriation act under which Congress provided for this work refers to it as "the special investigation of the possible economy of fuel, labor, and material resulting from the use in the Boston-Washington region of a comprehensive system for generating and distributing electricity to transportation lines and industries." Congress expected this intensive study to be completed within the fiscal year ended June 30, 1921, and in compliance with this expectation the manuscript report was in the hands of the director of the Geological Survey on July 1.

The superpower project makes its appeal to the general public as a means of saving coal and of increasing the productivity of labor. The Nation's business demands greater and cheaper production and better and cheaper transportation, and the electrification of industries and railroads is the answer to that demand. To connect all the large generating plants—both steam and water power—in one great system means more and cheaper electric current, because each ton of coal will be used to the best advantage and our idle rivers will be made to turn wheels, especially in the regions farthest removed from the coal fields.

Looking ahead to 1930, with the increased demand for power that can then be reasonably expected, the total coal saved annually under the unified system will be 50 million tons. Under motor operation the industries could save $190,000,000 annually in their power bill and could make a greater output of product. The ordinary citizen should also profit directly by the superpower system because it promises a reduction of one cent a kilowatt hour in the first cost of the current as put on the transmission lines. Cheaper electricity and more of it will bring comfort to the home as well as efficiency to the workshop, even though the reader may search this engineering report in vain for any basis whatever for the pleasant vision of electric-heated homes throughout our land. Superpower does not stand for the impossible but only for the wider application of practical engineering and sound economics.

The success of the Government's short-period study of so large a subject is due to the hearty co-operation with the Government bureau selected to administer the work of the engineering profession and of all the industries affected by the proposed larger electrification. W. S. Murray, of New York, who has been the moving spirit in urging the advantages of a unified power system, was appointed chief of the engineering staff and promptly organized the work. An advisory board of business men representing the railroads and industries interested added driving force to the investigation and gave a larger practical value to the completed report, which is now published by the United States Geological Survey as "Professional Paper 123." Secretary Fall has asked the members of this board to continue their public service in the further consideration of the legal and financial aspects of the superpower project, only the engineering features of which are presented in the report.

Collapsible Airplane

A baby airplane built to carry two hundred pounds and fitted with collapsible wings to allow it to be housed in a small garage has been set up at the General Electric Co.'s works in Pittsfield, Mass., by A. C. F. Isaac, a former designer for the Curtiss Airplane Co. The Pittsfield Aircraft Corporation is interested in the machine and its manufacture may be undertaken in Pittsfield. A feature of the plane is the quick-stop device, enabling it to alight in a small space. It is claimed the plane will start with a 25-ft. run from the roof of a building.

Japan Adopts Metric System

Since Japan broke her seclusion and joined the family of nations, how to adjust her weights and measures has been a problem of vital importance to her. The Japanese people are faced with the necessity of using three standards of measurement; their own age-long system; the pound, ounce, inch and foot measurements of America and England; and the metric system in use among the Latin nations. The inconveniences and hindrances to trade and industry arising from such different standards of weight and measure can easily be imagined. The Japanese government has, consequently, been studying the problem for several years from various angles. As a result the bill for the reform of weights and measures was drafted and introduced into the last session of the Diet. The House of Peers passed it with slight modifications. The amended bill also passed the House of Representatives on March 25 of this year, and was proclaimed by the Emperor, on April 12, as Law No. 71.

The bill stipulates that within the period of three to five years the metric system be adopted by government offices, government works, most of the leading factories, technical schools and others. The period of twenty years to come is, however, allowed for the adoption by the general public, after which the use of the metric system will be made compulsory. The reform is a marked step toward internationalization of Japan's economic structure, and ranks in importance with the adoption of the Gregorian Calendar at the beginning of the Meiji era.

The reasons for the reform bill and the procedure for its execution were fully set forth by the chairman, Dr. Imaidzumi, of the House Committee on the bill, when he reported it to the House Committee on the bill, when he reported it to the House of Representatives on March 25. He emphasized his belief that the metric system will in no distant future be adopted by America and Great Britain, the tendency toward which can be gaged by the recent resolution adopted by the League of Nations to recognize the Metric System Agreement made at Paris in 1876. He told the House that Japan will take no radical steps to introduce the reform, but proceed gradually to unify the standards of weight and measure. For government offices, technical schools and others, where the metric system has been used to some extent for the past ten years, three to five years will be sufficient for its complete adoption. So it will be with most of the factories. The exception has, however, to be made with the shipyards, cotton mills and the like, which import from America and England much of their machinery and materials. Much time will also be expended for the accomplishment of the reform in land cadaster. Strict enforcement of the law can be made within a certain period in all commercial transactions, while education would be the only means to secure general adoption by the public. Children learn in schools the use of the metric system, as the measurement is already adopted in their text-books. As the army uses the metric system, the sons of farmers and tradesmen who serve under the colors will return home accustomed to the use of the system. Consquently, twenty years are not short for the universal adoption of the system by the Japanese people.

Business Items

The Missouri, Kansas & Texas Railroad has sent out inquiries for machine tools comprising seventy-five items. This is said to be the largest list sent out by any railroad this year.

The Package Machinery Co., Springfield, Mass., has resumed full-time production on a basis of a 48-hour week. Wages were reduced simultaneously with the change of schedule.

The S. B. Sexton Stove and Manufacturing Co., Baltimore, Md., has purchased the entire property, equipment, etc., of the Isaac A. Sheppard Co., Excelsior Stove Works, Baltimore, for $101,000. The property was sold at auction by the receivers.

The Union Chain and Manufacturin Co., of Seville, Ohio through Walter Hay, vice-president and general manager, has purchased the plant of the Sandusky Drop Forge Co., in West Sandusky, and will locate there as soon as necessary alterations can be made.

Additional men are being put back to work at the plant of the Standard Steel Car Co. and manager W. C. Graham has announced that the plant would be operating 90 per cent of normal in a week. The plant employs about 600 men when operating capacity.

The Crane Machinery Co., 501 Morgan Bldg., Buffalo, N. Y., has been appointed exclusive distributor of the Sundstrand 9-in. manufacturing lathe in the Buffalo territory. The Crane company will also represent the Rockford Milling Machine Co., in Buffalo.

The Aumon Machinery Co., Baltimore, Md., has been appointed exclusive distributor for the Rockford Milling Machine Co. and the Rockford Tool Co. of Rockford, Ill., in the Baltimore territory.

The Seneca Falls Foundry Co. has recently rented the foundry of the Seneca Falls Manufacturing Co., Seneca Falls, N. Y.

The Peerless Machine Co., Racine, Wis., manufacturer of high-speed metal saws, announces substantial reductions in the prices of its Peerless saws. A dealers' discount on all types and sizes averages about 17 per cent.

The Anderson Piston Co., Bowling Green, Ohio, has purchased the plant and equipment of the Vim Motor Co., same city, and will establish its business in that factory. Work of remodeling the Vim plant is now under way, directed by C. C. Anderson, who will manage the new concern.

Consolidation of the Richardson-Phenix Co., Milwaukee, Wis., and the S. F. Bowser Co., Fort Wayne, Ind., with $10,000,000 assets, is announced. Personnel and names of both companies are to be retained, with headquarters in Fort Wayne. Pumps and storage systems have been the specialty of the Bowser concern, while the Rirchardson-Phenix Co. has manufactured appliances for the automatic lubrication of machinery and reclamation of lubricating oil.

The American Drop Forging Institute, Hanna Bldg., Cleveland, Ohio, has prepared a book for laymen entitled "What is a Drop Forging?" The book is said to cover the subject in an authoritative manner and is easily read by the student or non-technical man. A copy of the book will be mailed free upon request to the Institute.

Loy E. Nawrath Co., Newark, N. J., manufacturer of sheet metal machinery, has opened an office at 30 Church St., New York City.

The Cincinnati Hy-Speed Machine Co., Cincinnati, Ohio, has made exclusive selling arrangements with Niles-Bement-Pond Company. New literature on hy-speed drilling and automatic tapping machines is now being distributed.

The Oakley Machine Tool Co. has moved its factory and general offices from Cincinnati, Ohio, to Middletown, Ohio, where it will share a building with the Willard-Middletown Machine Co.

Personals

H. E. WITHAM, for twenty years with the Warner & Swasey Co., Cleveland, Ohio, has resigned his position as district sales manager in Chicago.

C. E. NEUBERT has been appointed district sales manager in Chicago for the Warner & Swasey Co. He was assistant to H. E. Witham in this territory for some time.

LIEUT. COL. EDWIN S. HARTSHORN has been relieved as director of sales of the War Department and as the War Department's member of the Federal Liquidation Board. His successor has not been named. The change was made necessary by the fact that Col. Hartshorn has completed a four-year term of duty with the General Staff. Since no exceptions are permitted in this statutory requirement, he must be given another assignment.

B. T. W. BURGESS, of London, England, has joined the factory staff of the Gilbert & Barker Manufacturing Co., of West Springfield, Mass., to obtain factory training prior to taking up his work in England for the general sales department.

J. F. CARATINI, of the general sales department of the Gilbert & Barker Manufacturing Co., Springfield, Mass., recently sailed from New York for Progresio, Mexico, and will proceed from there to Vera Cruz and Mexico City, in the interests of the company.

ELMER E. YAKE, formerly head of the Engineering Department of the Gilbert & Barker Manufacturing Co., Springfield, Mass., returned to the company on Oct. 1 to assume the duties of works manager, to which he was recently appointed. Mr. Yake left the Gilbert & Barker Co. in April, 1920, and went with the Walworth Manufacturing Co., at Kewanee, Ill., and at Boston, Mass., and later went with the C. & G. Copper Co., and had his offices at No. 30 Church Street, New York.

PHILIP W. GOEWEY, general manager and treasurer of the Pittsfield Machine and Tool Co., Pittsfield, Mass., has resigned. John Parker has been elected treasurer and Walter C. Reed manager.

WALTER E. HEIBEL, for the past two years Eastern district manager of the Wilmarth & Morman Co., has resigned to accept a position with the B. F. Sturtevant Co., Boston, Mass. Mr. Heibel will be located in New York.

ERNEST REICH, formerly vice-president of the Hill Pump Valve Co., Chicago, and general manager of plant of the Chicago Pressed Steel Co., has just returned from a seven months trip in Europe and is now engaged in utilization and marketing of domestic and foreign patents. Owners of meritorious inventions are invited to communicate with him, with the view of selling or exchanging the manufacturing rights of American patents for foreign inventions.

R. W. SHORE, manager of the New York office of the Defiance Machine Works, Defiance, Ohio, has returned to the home office.

E. E. BARTO, for the past three years production manager of the Indiana Rolling Mill Co., New Castle, Ind., has joined the Warren Iron and Steel Co., Warren, Ohio, as production manager. For 15 years prior to his Indiana Rolling mill connection, Mr. Barto was rolling mill superintendent for the Jessop Steel Co., Washington, Pa.

W. F. ABEL has been appointed assistant general manager of sales of the Electric Alloy Steel Co., Youngstown, Ohio.

GEORGE L. SAWYER, formerly sales manager of material building machinery for the Barber-Greene Co., Aurora, Ill., has been appointed New York representative of the Universal Crane Co. of Elyria, Ohio, with offices at the Allied Machinery Center, New York City.

FRANK H. LONDON of Chicago, Ill., has been made district representative in the Chicago territory for the Falcon Steel Co., Niles, Ohio.

Obituary

JOHN BOYD DUNLAP, known as the inventor of the pneumatic tire, died at his home in Dublin, Ireland, on Oct. 24. He was 81 years old. His invention, first introduced in 1888, revolutionized bicycling and was a forerunner to the success of automobiling.

Catalogs Wanted

Ernest Reich, formerly vice-president of the Hill Pump Valve Co., and general manager of the Chicago Pressed Steel Co., Chicago, Ill., is now established at 11 So. LaSalle St., Chicago, Ill., as exporter and importer. He would like to receive catalogs and quotations for novel manufacturing equipment, for which he has established markets abroad.

Forthcoming Meetings

The third annual convention and exhibition of the American Gas Association will be held in the Congress and Auditorium Hotels, Chicago, Ill., on Nov. 7 to 12.

The twenty-fifth annual convention of the National Founders' Association will be held in the Hotel Astor, New York City, on Nov. 16 and 17.

The annual meeting of the Taylor Society will be held in the Engineering Societies Building, New York City, on Dec. 1, 2 and 3.

The annual meeting of the American Society of Mechanical Engineers will be held in the Engineering Societies Building, New York City, on Dec. 5 to 9.

NEW *and* ENLARGED

Machine Tools and Machinery Wanted

Machine-tool wants published without charge

Mass., Boston—Hill, Clark & Co., Inc., 1560 Oliver St.—one 18 in. Gisholt turret lathe and one 110 in. vertical boring mill.

Mass., Worcester—The Baldwin Chain & Mfg. Co., A. W. Warren, Purch. Agt.—Schuster riveting machine having capacity of ¾ in., ⅞ in. up to 1¼ in.

N. Y., Buffalo—The Electro Refractory Co., Ellicott Sq., (steel crucibles) L. V. Milward, Secy.—equipment and machinery for machine shop and factory.

N. Y., New York—The Tiffany Electric Co., 165 Bway.—radio drill and wet grinder for new plant in Jersey City.

N. C., Salisbury—The Amer. Fdry. Co., T. G. Shelton, Mgr.—machine tools, including lathes, drill presses, planer, shaper, hack saw, pipe threading machine, etc.; foundry equipment, including 3 to 4 ton per hour capacity cupola, blower, tumbling barrels, brass furnace, ladles, etc. (used if in good condition).

Tenn., Memphis—The Riechman Crosby Co., 235 South Front St., H. H. Crosby, Purch. Agt.—one key-seater to have range from ¼ in. to 1 in. inclusive, Davis, Mitts Merrill or similar preferred (used).

Va., Richmond—Hackley Morrison Co., 1010 4th Ave.—one 16 in. and one 20 in. crank shaper. One 4 in. centrifugal sand pump. Two 20 in. upright drills.

Ill., Aurora—The All Steel Equipment Co.—two No. 6 Magara presses (not geared).

Mich., Detroit—J. C. Austerberry, 684-690 East Congress St.—Morton auto parts grinder or its equivalent, one No. 55, No. 60 and No. 65 Heald grinders, one Springfield lathe to take 14 in. by 60 in. swing or its equivalent, and one Etna swaging machine, capacity to take ⅞ in. copper tubing.

Mich., Niles—The National Sandard Co., M. Johnson, Purch. Agt.—swaging machine to point ⅞ in. diameter, copper tubes having at least 6 in. die length.

O., Columbus—The Bull Co., 602 Hartman Bldg., C. H. Bull, Prs. and Genl. Mgr.—shop machinery for the manufacture of new style spark plug.

O., Columbus—The Carroll Chain Co., 63 Smith Pl., D. Carroll, Prs.—$25,000 worth of equipment for forging chains.

Wis., Columbus—The Columbus Auto Repair & Paint Co., F. Menke, Purch. Agt.—pneumatic brushes and equipment including presses, lathe, etc. for auto repair shop.

O., Findlay—The Adams Axle Co.—special machinery for machining axles.

O., Marion—The Noles Water Filter Co., 180 North Main St., C. M. Burkett, Purch. Agt.—metal working machinery.

Wis., Darien—Matteson & Bartlett, F. Matteson, Purch. Agt.—machinery for auto repair shop.

Wis., Eagle River—J. B. Cook, (machinist) machine shop equipment including drill press.

Wis., Glenwood City—The Glenwood City Auto Co., J. P. Johnson, Purch. Agt.—auto repair shop equipment including air compressors, lathes, etc.

Wis., Hartford—H. Lohr, North Main St.—presses (1 and 2 tons), lathe and equipment for auto repair work.

Wis., Mazomanie—L. P. Schoelkopf—machine tools including presses, etc., for garage.

Wis., Milwaukee—Kaczmarek & Nowicki, 6 Chambers St.,—lathe and possibly a drill press for machine work and blacksmith shop.

Wis., Milwaukee—Smith Specialty Mfg. Co., 503 East Water St.—30 in. squaring shears.

Wis., Neenah—The Bergstrom Paper Co., Orbison & Orbison, Appleton, Engrs.—equipment including lathes, hammer, etc. for proposed machine shop.

Mo., Joplin — The Mooman Tool & Machine Co., 113 Main St.—machinery for the manufacture of lathes, boring machines and tools.

Mo., St. Louis—The Missouri, Kansas & Texas R.R., G. E. Scott, Purch. Agt., has issued a supplementary list for machine tools requirements

Mo., West Plains—The Bd. Educ.—lathes, machinists and carpenters tools, for machine shops on Main St.

Ont., Amherstburg — The Midwestern Tractor Wheel Co., H. H. Lane, Mgr.—equipment including metal working machinery, lathes, planers, etc., for proposed factory.

W. I., Haiti, Santiago—E. J. Espaillat—one 15 in. x 7 ft. or 15 in. x 8 ft. south bend gap lathe or similar, regular equipment and combination chuck 12 to 15 in., (used).

Md., Hagerstown — Vicama Mica Co., 3 Hamilton Row—J. W. Feldman, Purch. Agt.—machinery and equipment for mining mica and feldspar, also grinding machinery for mica and feldspar.

N. J., Newark—Kreuter & Co., 571 18th Ave.—one No. 2 B. American rotary carbonizing furnace.

N. Y., Buffalo—The Amer. Grain & Feed Corp., 303 Chamber of Commerce, L. R. Veatch, Prudential Bldg., Engr.—flour mill machinery, also equipment and machinery for the proposed elevator and feed mill.

Pa., Johnstown—The Pennsylvania Bedding Mfg. Co., 121-23 B. St., mattress making machines for plant at Morrellville.

Pa., Philadelphia—Collins & Aikman, 51st St. near Parkside Ave. weaving machinery, looms, etc. for proposed plush factory.

Ala., Fort Payne—The Fort Payne Ice Co., A. A. Miller, Purch. Agt.—machinery and equipment for a 10-ton ice plant.

Ga., Woolsey—J. A. Spurlin—machinery for the manufacture of Tupelo gum trays also machinery to make handles from hickory wood.

Miss., Meridian—The Bang-Go Soap Mfg. Co., L. L. Gunn, Vice-Pres. and Mgr.—machinery and equipment for the manufacture of soap in cake and paste form, including cooking, cooling, pressing and wrapping machinery.

N. C., Bessemer City—J. M. Torrence (stone crushing)—jaw crusher with elevator and screen, 60 to 125 ton daily capacity of 2 in. or smaller stone (used if in good condition).

N. C., Littleton — E. E. Wollert & Son, band resaw (used).

S. C., Badham—Dorchester Lumber Co., V. C. Badham, Pres. and Treas.—8 ft. band saw mill, 60 in. edger, 5 saw trimmer, No. 6 Mitts & Merrill hog, 5,6 and 7 ft. band resaw (prefer vertical Mershon), self feed bond rip saw, two 6 x 16 in. 6 knife planers, etc., for proposed mill at Garnett.

S. C., Camden—S. F. Brasington, woodworking machinery for manufacture of spokes and handles.

S. C., Saluda — R. M. Etheridge—planer knife grinder.

Tenn., Dayton—The Print Shop, W. H. Moss, Purch. Agt.—printing machinery and supplies, including rule and lead cutting machines (new or used), also small and medium priced paper cutters.

Ill., Amboy—The Bd. Educ.—manual training equipment for proposed high school.

Ill., Chicago—The Trio Camera & Film Co., 6500 East Ravenswood Ave.—one 2-A Brown & Sharpe universal miller.

Ill., Danville—The Bd. Educ., c/o W. Smith, Prs.—manual training equipment for proposed High School.

Ill., Freeport—The Bd. Educ., c/o S. E. Raines, Supt.—manual training equipment for proposed high school.

Wis., Beaver Dam—The Beaver Dam Bottling Wks., O. H. Strum, Racine, Purch. Agt.—electric power machinery, bottle capping machinery, washers, etc.

Wis., Hartford — Gehl Bros.—marble polishing machines.

Wis., Merrill—The Lincoln Milling & Elevator Co., P. Gebhardt, Purch. Agt.—machinery for grinding grain.

Wis., Milwaukee—W. Erni, 3928 Vliet St.—one medium size electric spot welding machine.

Wis., Milwaukee—R. C. Schumacker, 2037 Fond-du-lac Ave.—one 12 to 16 in. paper cutting machine.

Wis., Oconomowoc—F. Pabst Co.—humidifier, ice machine, coolers, and special machinery for the manufacture of dairy products.

Wis., Rib Lake—C. R. Claussen and G. F. Braun—woodworking machinery for the manufacture of furniture and chairs.

Wis., Stevens Point—The Bd. Educ., J. M. Pfiffner, Chn.—wood-working machinery for proposed vocational school on Clark St.

Ark., Eureka Springs—H. D. Jenkins—machinery for ice plant at Gravette.

Mo., Ash Grove—The Ash Grove Ice Plant Co.—ice making equipment and machine tools for handling ice.

The Weekly Price Guide

This Week's Market

Structural steel shapes, plates and bars, still quoted at the Pittsburgh mills at $1.50 @ $1.65 per 100 lb., the lower figure applying mostly to the larger tonnages, small tonnages selling at $1.60 @ $1.65 per 100 lb. Mill shipments, New York, of structural shapes and plates are quoted at $1.88 @ $2.03; bars at $1.80 @ $1.88 per 100 lb. Warehouse prices and quotations on mill shipments have remained firm throughout the week; with the exception of blue annealed steel sheets, which have advanced 25c. per 100 lb. on all sizes at the New York warehouses. No. 10 blue annealed sheets are quoted at $3.53 as against $3.28 per 100 lb. one week ago.

No other changes.

IRON AND STEEL

PIG IRON—Per gross ton—Quotations compiled by The Matthew Addy Co.:

CINCINNATI	
No. 2 Southern	$24.50
Northern Basic	22.52
Southern Ohio No. 2	23.52
NEW YORK—Tidewater Delivery	
Southern No. 2 (Silicon 2.25 to 2.75)	30.26
BIRMINGHAM	
No. 2 Foundry	20.00
PHILADELPHIA	
Eastern Pa., No. 2x, 2.25-2.75 sil	22.75
Virginia No. 2	28.74
Basic	20.75
Grey Forge	21.75
CHICAGO	
No. 2 Foundry local	22.70
No. 2 Foundry, Southern, sil 2.25@2.75	26.66
PITTSBURGH, including freight charge from Valley	
No. 2 Foundry	22.96
Basic	21.96
Bessemer	21.96

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the base quotations from mill:

Blue Annealed	Pittsburgh, Large Mill Lots	New York	Cleveland	Chicago
No. 10	2.50	3.53	3.10	3.38
No. 12	2.55	3.58	3.15	3.45
No. 14	2.60	3.63	3.20	3.48
No. 16	2.80	3.73	3.30	3.58
Black				
Nos. 17 and 21.	2.85	4.05	3.55	3.95
Nos. 22 and 24.	2.90	4.10	3.60	4.00
Nos. 25 and 26.	2.95	4.15	3.65	4.05
No. 28	3.00	4.25	3.75	4.15
Galvanized				
Nos. 10 and 11.	3.00	4.25	3.75	4.15
Nos. 12 and 14.	3.10	4.35	3.85	4.25
Nos. 17 and 21.	3.40	4.65	4.15	4.55
Nos. 22 and 24.	3.55	4.80	4.30	4.70
No. 26	3.70	4.95	4.55	4.85
No. 28	4.00	5.25	4.75	5.15

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the latest Pittsburgh basing card:

Steel Inches	Black	Galv.	BUTT WELD Inches	Iron Black	Galv.
1 to 3	68½	56	⅜ to 1½	44½	29½
LAP WELD					
2	61½	49	2	39½	25½
2½ to 6	65½	53	2½ to 4	42½	29½
7 to 8	62½	49	4½ to 6	42½	29½
9 to 12	62½	49	7 to 12	40½	27½
BUTT WELD, EXTRA STRONG, PLAIN ENDS					
1 to 1½	66½	55	1 to 1½	44½	30½
2 to 3	68½	56			
LAP WELD, EXTRA STRONG, PLAIN ENDS					
2	59½	48	2	40½	27½
2½ to 4	63½	52	2½ to 4	43½	31½
4½ to 6	62½	51	4½ to 6	42½	30½
7 to 8	58½	45	7 to 8	35½	23½
9 to 12	52½	39	9 to 12	30½	18½

Malleable fittings. Classes B and C, Banded, from New York stock sell at net list. Cast iron, standard sizes, 20–5% off.

WROUGHT PIPE—Warehouse discounts as follows:

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
1 to 3 in. steel butt welded	60%	46%	60½%	47½%	60%	46%
3½ to 6 in. steel lap welded	51%	37%	58½%	44½%	57%	43%

Malleable fittings. Classes B and C, Banded, from New York stock sell at list less 5%. Cast iron, standard sizes, 32% off.

MISCELLANEOUS—Warehouse prices in cents per pound in 100-lb. lots:

	New York	Cleveland	Chicago
Open hearth spring steel (base)	5.00	6.00	*3.78
Spring steel (light) (base)	6.00	6.00	*2.93
Coppered Bessemer rods (base)	8.00	8.00	*6.03
Hoop steel	3.88	3.29	3.48
Cold rolled strip steel	7.50	8.25	6.75
Floor plates	4.85	....	5.23
Cold finished shafting or screw	3.88	3.50	3.83
Cold finished flats, squares	4.38	4.00	4.35
Structural shapes (base)	2.88	2.74	2.88
Soft steel bars (base)	2.78	2.64	2.78
Soft steel bar shapes (base)	2.78	2.64	2.78
Soft steel bands (base)	3.43	....	3.48
Tank plates (base)	2.88	2.92½	2.88
Bar iron (2.15@2.25 at mill)	2.78	3.52	2.78
Drill rod (from list)	55@60%	55%	50%
Electric welding wire			
⅜	8.50		12@13
¼	7.15		11@12
5/32 to ¼	6.75		10@11

* Price to Dealers.

METALS

Current Prices in Cents Per Pound

	New York	Cleveland	Chicago
Copper, electrolytic (up to carlots), New York			13.62½
Tin, 5-ton lots, New York			28.50
Lead (up to carlots), St. Louis, 4.60; New York			5.00
Zinc (up to carlots), St. Louis, 4.97½; New York			5.37½
Aluminum, 98 to 99% ingots, 1-15 ton lots	25.00	20.00	20.00
Antimony (Chinese), ton spot	5.50	6.50	6.00
Copper sheets, base	20.75	21.50	22.50
Copper wire (carlots)	16.50	16.50	15.75
Copper bars (ton lots)	19.00	23.00	19.00
Copper tubing (100-lb. lots)	20.50	23.00	22.50
Brass sheets (100-lb. lots)	16.25	17.00	18.25
Brass tubing (100-lb. lots)	18.00	19.00	20.00
Brass rods (1,000-lb. lots)	14.25	16.00	15.25
Zinc sheets (casks), (8% dis. carlots)	11.00	11.15	15.75
Nickel (ingot and shot), Bayonne, N. J.	41.00	.....	.....
Nickel (electrolytic), Bayonne, N. J.	44.00	.....	.....
Solder (½ and ½), (case lots)	19.50	23.50	18.00
Babbitt metal (best grade)	70.00	39.00	34.00
Babbitt metal (commercial)	30.00	13.50	8.00

—Shop Materials and Supplies

MONEL METAL—Base price in cents per lb., f.o.b. Bayonne, N.J.:

Shot	35.00	Hot rolled machined rods (base)	53.00
Blocks	35.00	Hot rolled rods (base)	42.00
Ingots	38.00	Cold drawn rods (base)	56.00
Sheet bars	40.00	Hot rolled sheets (base)	55.00

SPECIAL NICKEL AND ALLOYS—Price in cents per lb.

Malleable nickel ingots	45
Malleable nickel sheet bars	47
Hot rolled rods, Grades "A" and "C" (base)	60
Cold drawn rods, Grades "A" and "C" (base)	72
Copper nickel ingots	37
Hot rolled copper nickel rods (base)	45
Manganese nickel hot rolled (base) rods "D"—low manganese	64
Manganese nickel hot rolled (base) rods "D"—high manganese	67

OLD METALS—Dealers' purchasing prices in cents per pound:

	New York	Cleveland	Chicago
Copper, heavy, and crucible	10.00	10.50	10.25
Copper, heavy, and wire	9.50	10.50	9.50
Copper, light, and bottoms	8.00	8.00	8.25
Lead, heavy	4.00	3.75	3.75
Lead, tea	3.00	2.75	3.00
Brass, heavy	6.50	6.00	8.00
Brass, light	5.00	4.00	4.75
No. 1 yellow brass turnings	5.25	4.50	5.25
Zinc	3.00	2.00	2.75

TIN PLATES—American Charcoal Plates—Bright—Cents per lb

	New York	Cleveland	Chicago
"AAA" Charcoal Melyn Grade:			
IC, 20x28, 112 sheets	21.50	.....	.....
IX, 20x28, 112 sheets	24.00	.....	.....
"A" Charcoal Allaways Grade:			
IC, 20x28, 112 sheets	18.50	.....	.....
IX, 20x28, 112 sheets	21.50	.....	.....
Coke Plates, Bright			
Prime, 20x28 in.:			
100-lb., 112 sheets	14.30	13.00	14.50
IC, 112 sheets	14.30	13.30	14.80
Terne Plate			
Small lots, 8-lb. Coating:			
100-lb., 14x20	7.50	6.25	7.25
IC, 14x20	7.75	6.50	7.40

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb	$0.07½@$0.10	$0.12	$0.12
Cotton waste, mixed, per lb	.055@.09	.09	.10
Wiping cloths per M., 13¼x13¼	.....	55.00	55.00
Wiping cloths per M., 13¼x20¼	.....	65.00	65.00
Sal soda, 100 lbs	2.10	3.00	2.65
Roll sulphur, 2-bbl. lots per 100 lb	2.55	3.25	3.50
Linseed oil, per gal., 5 bbl. lots	.72	.80	.72
White lead, dry or in oil	100 lb. kegs.	New York, 12.25	
Red lead, dry	100 lb. kegs.	New York, 12.25	
Red lead, in oil	100 lb. kegs.	New York, 13.75	
Fire clay, per 75 lb. bag		.80	1.00
Coke, prompt furnace, Connellsville	per ton	$3.25@3.50	
Coke, prompt foundry, Connellsville	per ton	4.25@4.75	

SHOP SUPPLIES

	New York	Cleveland	Chicago
Machine Bolts:			
All sizes up to 1x30 in.	—50%	—60%	—60%
1⅛ and 1¼x3 in. up to 12 in.	—40%	—60-10-10%	—55%
With cold punched sq. nuts	—30%	.....	....
With hot pressed hex. nuts up to 1x30 in. (plus std. extra of 10%)	—40%	.....	$3.25 off
Button head bolts, with hex. nuts	—20%	$3.90 net	.....
Hex. head and hex. nut bolts	—20%	.....	.....
Lag screws, coach screws	—50-10%	.....	—60%
Carriage bolts, all sizes up to 1 in. x 30 in.	—45%	—50-10-10%	50-5%
Bolt ends, with hot pressed nuts	—50%	.....	—55%
Tap bolts, hex. heads	—20%	.....	.....
Semi-finished nuts all sizes	—70%	—75%	—80%
Case-hardened nuts	—60%	.....	.....
Washers, cast iron, ½ in., per 100 lb. Off list	$5.00	$5.50	$4.50
Washers, cast iron, ⅜ in. per 100 lb. Off list	4.25	3.75	4.50
Washers, round plate, per 100 lb. Off list	3.00	....	4.50
Nuts, hot pressed, sq., per 100 lb. Off list	2.00	3.00	3.25
Nuts, hot pressed, hex., per 100 lb. Off list	2.00	3.00	3.25
Nuts, cold punched, sq., per 100 lb. Off list	1.50	3.00	3.25
Nuts, cold punched, hex., per 100 lb. Off list	1.50	3.00	3.25
Rivets:			
Rivets, 7/16 in. dia. and smaller	—50-10%	60-10-10%	—60-10%
Rivets, tinned	—50-10%	60-10-10%	4½c. net
Button heads ¾-in., ⅞-in., 1x2 in. to 5 in., per 100 lb (net)	$3.70	3.50	3.68
Cone heads, ditto (net)	3.80	3.60	3.78
1⅛ to 1⅞-in. long, all diameters, *EXTRA* per 100 lb	0.25	.....	0.15
⅞ in. diameter *EXTRA*	0.15	.....	0.15
½ in. diameter *EXTRA*	0.50	.....	0.50
1 in. long, and shorter *EXTRA*	0.50	.....	0.50
Longer than 5 in. *EXTRA*	0.25	.....	0.25
Less than 200 lb. *EXTRA*	0.50	.....	0.50
Countersunk heads *EXTRA*	0.35	.....	$4.28 base
Copper rivets	—50-10%	—40-10%	—50-10%
Copper burs	—25-10%	—15%	—10%
Lard oil, pure, (50 gal. bbl.) per gal.	0.95	.....	.....
Lard cutting oil (50 gal. bbl.) per gal.	0.60	.....	.....
Machine oil, lubricating, per gal.	0.40	.....	.....
Belting—Present discounts from list in fair quantities (½ doz. rolls)			
Leather:			
Light grade	50-5%	.....	50-5%
Medium grade	45%	.....	.....
Heavy grade	40%	.....	.....
Rubber and duck:			
First grade	50-10%	.....	.....
Second grade	60-5%	.....	60-5%
Abrasive materials—In sheets 9x11 in.:			
No. 1 grade, per ream of 480 sheets,			
Flint paper	$9.00 less 20-10-5%		—20-10%
Emery paper	11.00 less 20%	.....	—20%
Emery cloth	32.75 less 10%	.....	—10%
Flint cloth, regular weight, width 3½ in., No. 1 grade, per 50 yd. roll, $4.50 net		.....	list+10%
Emery discs, 6 in. dia., No. 1 grade, per 100.			
Paper	$1.65 less 20%	.....	—10%
Cloth	$3.55 less 10%	.....	—10%

Mo., Carthage—F. W. Steadly, 930 Oak St., tools and machinery for stone quarries.

Mo., St. Louis—Larkin & Pratt, 876-8 Arcade Bldg., D. Larkin, Purch. Agt.—machinery and equipment for sugar plant with capacity of grinding 400 ton of sugar cane per day, including cane crushed, mill triple-effect evaporator and equipment, filter, presses, boilers, pumps, etc., also machinery and apparatus for canning plant, etc.

Ont., Chatham—The Chatham Chrystal Ice Co.—machinery for artificial ice plant.

Ont., Walkerville—The School Bd., A. E. Cock, Secy.—equipment for chemistry laboratory and manual training work.

Metal Working Shops

NEW ENGLAND STATES

Conn., Meriden—Griswold, Richmond & Glock Co., 2 West Main St., has awarded the contract for the construction of a 1 story, 50 x 160 ft. addition to its sheet metal plant on West Main and South Grove Sts. Estimated cost, $40,000.

Mass., Boston—Tuck & Gilman, Archts., 34 School St., are receiving bids for the construction of a 2 story, 75 x 150 ft. garage on Maywood St., for H. Freedman, c/o architects. Estimated cost, $75,000.

Mass., Brookline—L. A. Vachon, 653 Washington St., has awarded the contract for the construction of a 2 story, 60 x 148 ft. garage and service station on Washington St. Estimated cost, $80,000.

Mass., Cambridge—The Mack Motor Truck Co., 185 Massachusetts Ave., has awarded the contract for the construction of a 1 story, 45 x 110 ft. factory addition on Osborn St. Estimated cost, $40,000.

Mass., East Long Meadow—The New England Steel Castings Co., Shaker Rd., is receiving bids for the construction of a 1 story, 70 x 125 ft. casting plant. Estimated cost, $40,000. M. W. Maloney, 145 Chestnut St., Springfield, Archt. Noted June 23.

Mass., Southbridge — The Southbridge Fdry. Co., has awarded the contract for the construction of a 1 story, 50 x 100 ft. foundry on Worcester St.

R. I., Providence — W. G. Richards, Archt., 17 Exchange St., is receiving bids for the construction of a 2 story, 90 x 120 ft. garage and service station, for the Dorrance St. Garage, Dorrance and Friendship Sts. Estimated cost, $75,000.

MIDDLE ATLANTIC STATES

Md., Cumberland—The Paragon Motor Car Co., 133 Baltimore St., has awarded the contract for the construction of a 1 and 2 story, 60 x 400 and 400 x 540 ft. motor car plant. Estimated cost, $1,000,000. Noted June 9.

N. Y., Brooklyn—The Royal Metal Furniture Co., 125 8th St., will build a 3 story, 75 x 200 ft. foundry and paint plant on 8th St.

Pa., Morrellville—(Johnstown P.O.)—The Pennsylvania Bedding Mfg. Co., 121-23 B. St., Johnstown, manufacturer of mattresses, springs, cot-beds, etc., has awarded the contract for the construction of a 3 story, 36 x 86 ft. factory on B. St., here. Estimated cost, $40,000.

Pa., Philadelphia—The Dept. of Pub. Wks., City Hall, will soon award the contract for the construction of a 1 story, 50 x 160 ft. garage and machine shop on Fairmount and Delaware Aves. P. B. Sinkler, City Hall, Archt.

Pa., Philadelphia—E. Shoppe, Archt., 315 South 15th St., will receive bids until Nov. 15 for the construction of a 1 story, 60 x 100 ft. sales and service station at 4653 Paul St., for the Roth Buick Co., Frankford Ave. and Oxford Pike. Estimated cost, $50,000.

SOUTHERN STATES

Ky., Louisville—Yost & Cook, 231 South 5th St., have awarded the contract for the construction of a 1 story, 150 x 200 ft. garage at 649-657 South 3rd St. Estimated cost, $80,000.

MIDDLE WEST STATES

Ill., Centralia—J. Longenfeld has awarded the contract for the construction of a 2 story, 80 x 106 ft. garage. Estimated cost, $40,000. Noted Oct. 27.

Ill., Chicago—A Bromstedt, 6440 South Green St., has awarded the contract for the construction of a 1 story, 50 x 200 ft. garage at 6022-24 Stony Island Ave. Estimated cost, $40,000.

Ill., Chicago—Spingola & Sons, 750 Taylor St., have awarded the contract for the construction of a 2 story, 75 x 120 ft. garage at 1918 South Morgan St. Estimated cost, $50,000.

Ill., McHenry—The Bogner Auto Co. is having plans prepared for the construction of a 2 story garage. Estimated cost, $40,000. H. B. Dox, Lehmann Bldg., Peoria, Archt.

Mich., Ferndale—The Leasia Motor Sales Co., c/o Arnold & Shreve, Archts., 308 Homber Bldg., Highland Park, has had plans prepared for the construction of a 2 story garage, service and sales building on Woodward Ave. and Nine Mile Rd. Estimated cost, $40,000.

O., Warren—D. E. Miller has awarded the contract for the construction of a 2 story, 80 x 120 ft. garage on West Market St. Estimated cost, $64,000.

Wis., Madison—The Purcell Wischau Co., 219 East Washington St., has awarded the contract for the construction of a 2 story, 117 x 132 ft. garage on Gilman St. Estimated cost, $150,000. Noted Oct. 27.

Wis., Mazomanie—L. P. Schoelkopf has awarded the contract for the construction of a 2 story, 60 x 95 ft. garage. Estimated cost, $55,000.

WEST OF THE MISSISSIPPI

Kan., Council Groves—E. A. Roberts has awarded the contract for the construction of a 2 story garage. Estimated cost, $45,000. Noted Nov. 3.

Minn., St. Paul—W. Fernholz, 1046 East 4th St., plans to construct a 1 story, 50 x 180 ft. garage on Hastings Ave. and Cypress St. Estimated cost, $40,000. Architect not selected.

Mo., Joplin—The Mooman Tool & Machine Co., 113 Main St., plans to construct a factory. Estimated cost, $50,000. Architect not selected.

Mo., St. Joseph—W. T. Littlejohn, 6106 Kinghill Ave., has awarded the contract for the construction of a 1 story, 54 x 135 ft. garage on Kinghill Ave. and Valley St. Estimated cost, $45,000.

Mo., St. Louis—J. E. Dougherty, 127 Blow Ave., will build a 2 story garage on 39th and McRee Aves. Estimated cost, $45,000. Noted Nov. 3.

Mo., St. Louis—The White Co., (auto trucks), 3442 Lindell St., will build a 1 story service station on Laclede and Vanderventer Sts. Estimated cost, $75,000. Noted Nov. 3.

Mo., West Plains—The Bd. Educ. has had plans prepared for the construction of a 2 story, 80 x 120 ft. machine shop for vocational training, on Main St. Estimated cost, $12,000. Heckenlively & Mark, Landers Bldg., Springfield, Archts.

WESTERN STATES

Cal., Stockton—San Joaquin County will soon award the contract for the construction of a garage and shop building at the San Joaquin General Hospital. R. P. Morrell, Stockton, Archt.

CANADA

Ont., Amherstburg — The Midwestern Tractor Wheel Co. has purchased a site and plans to build a factory. Estimated cost, $50,000. H. H. Lane, Mgr. Private plans.

General Manufacturing

NEW ENGLAND STATES

Mass., Salem—The Atlantic Oil Refining Co., 1211 Chestnut St., Phila., Pa., is having plans prepared for the construction of a large oil plant on Jefferson Ave., here. Private plans.

MIDDLE ATLANTIC STATES

N. J., Homestead—The Atlas Finishing Co., will soon award the contract for the construction of a 3 story factory on Patterson Rd., for finishing dyes, etc. Estimated cost, $100,000. R. G. Gory, 50 Church St., New York City, Archt. and Engr.

Pa., Braddock—The Diamond Ice Co. has awarded the contract for the construction of 1 and 2 story, 30 x 44 ft., 10 x 40 ft. and 15 x 29 ft. additions to its ice plant on 6th St. Estimated cost, $50,000.

Pa., Dorranceton (Kingston P.O.)—M. F. Fadden has had plans prepared for the construction of a 2 story, 58 x 91 ft. ice cream plant. Estimated cost, $90,000. The McCormick Co., Century Bldg., Pittsburgh, Archts.

Pa., Harrisburg—The School Dist., 121-23 Chestnut St., has awarded the contract for the construction of a 1 story, 120 x 200 ft. shop. Estimated cost, $21,231. Noted Oct. 20.

Pa., Philadelphia—Collins & Aikman, 51st. St. near Parkside Ave., have awarded the contract for the construction of a 3 story, 55 x 65 ft. plush factory on 51st. and Viola Sts. Estimated cost, $35,000.

D. C., Langdon (Washington P. O.)—The Fleischmann Yeast Co., will soon award the contract for altering and building an addition to its plant. Milburn, Heister & Co., Union Savings Bank Bldg., Archts.

SOUTHERN STATES

N. C., Raleigh—The State School for the Blind will soon award the contract for the construction of an institutional school, including a laundry, etc., on the campus. Estimated cost, $200,000. J. A. Salter, Commercial Bldg., Archt. Noted Oct. 13.

MIDDLE WEST STATES

Ill., Centralia—The Chicago, Burlington & Quincy R.R., 542 West Jackson Blvd., Chicago, has awarded the contract for the construction of a round house and coal chute, here. Estimated cost, $125,000. Noted Oct. 20.

Ill., Jonesboro—The Union Grain & Milling Co., plans to construct a 2 story flour mill. Estimated cost, $40,000. Architect not selected.

Ill., Lockport — The Northern Illinois Cereal Co. is having plans prepared for the construction of a 1 story, 80 x 350 ft. factory. Estimated cost, $100,000, C. W. Buckley, Prs. C. W. Webster, Cutting Blk., Joliet, Archt.

Ill., Peoria—Leshnick Directory Co., 514 Main St., will soon award the contract for the construction of a 2 story, 50 x 150 ft. printing plant. Estimated cost, $100,000. B. L. Hulsebus, Jefferson Bldg., Archt. Noted Nov. 3.

O., Cleveland—Pavelka Bros., 2978 East 37th St., have awarded the contract for the construction of a 1 story, 57 x 65 ft. addition to their sausage factory on 37th St. and Bway. Estimated cost, $40,000. Noted Oct. 20.

Wis., Oconomowoc—F. Pabst has awarded the contract for the construction of a 1 story, 62 x 70 ft. cheese factory on his farm near here. Estimated cost, $20,000.

Wis., Rhinelander—The S. Miller Gold Storage Co., Marshfield, plans to construct a 2 story, 80 x 150 ft. cold storage plant, here. Estimated cost, $150,000. Architect not selected.

WEST OF THE MISSISSIPPI

Kan., Coffeyville—E. R. Lawson, Nowata, Okla., has awarded the contract for the construction of a 1 and 2 story ice plant, here. Estimated cost, $100,000. Noted Oct. 6.

Minn., Minneapolis—The Franklin Co-operative Creamery Assn., 2601 Franklin Ave., plans to construct a 2 or 3 story creamery on the North Side. Estimated cost, $55,000. H. I. Norby, Pres. Architect not selected.

Mo., Ash Grove—The Ash Grove Ice Plant Co. plans to build a 1 story plant on Main St., for the manufacture of ice. Estimated cost, $15,000. Private plans.

Mo., Carterville—F. W. Wasserman, Joplin, is having plans prepared for the construction of a 1 story, 40 x 80 ft. factory on Main St., here, for the manufacture of concrete blocks with marble face. Estimated cost, $5,000. Private plans.

CANADA

Ont., Chatham — The Chatham Crystal Ice Co. is having plans prepared for the construction of an artificial ice plant. Estimated cost, $60,000. J. W. Leighton, Bartlett Bldg., Windsor, Archt.

Ont., Sandwich—The Essex County Council, c/o W. P. Coyle, 472 Sandwich St., Windsor, will soon receive bids for the construction of a 2 story, 150 x 200 ft. jail, including a laundry, etc. Estimated cost, $250,000. Nichols, Sheppard & Colthurst, Windsor, Archts.